



Aeronautical
Engineering
A Continuing
Bibliography
with Indexes

NASA SP-7037(167)
November 1983

National Aeronautics and
Space Administration



25th Anniversary
1958-1983



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N83-30354 - N83-32706

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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 167)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in October 1983 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



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1983

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 530 reports, journal articles, and other documents originally announced in October 1983 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

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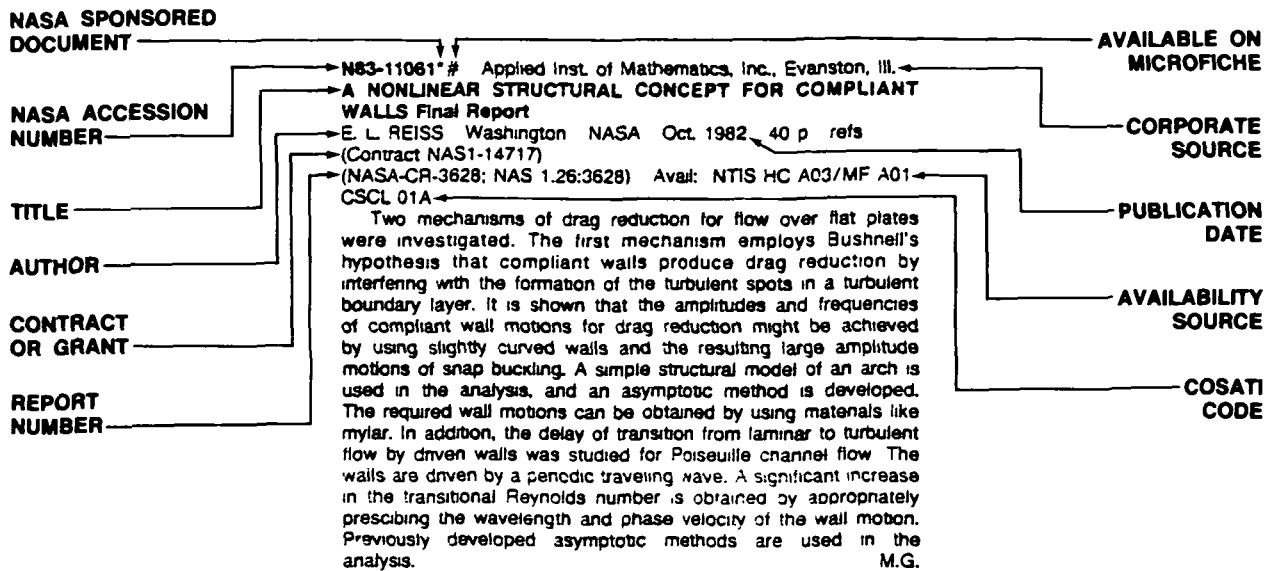
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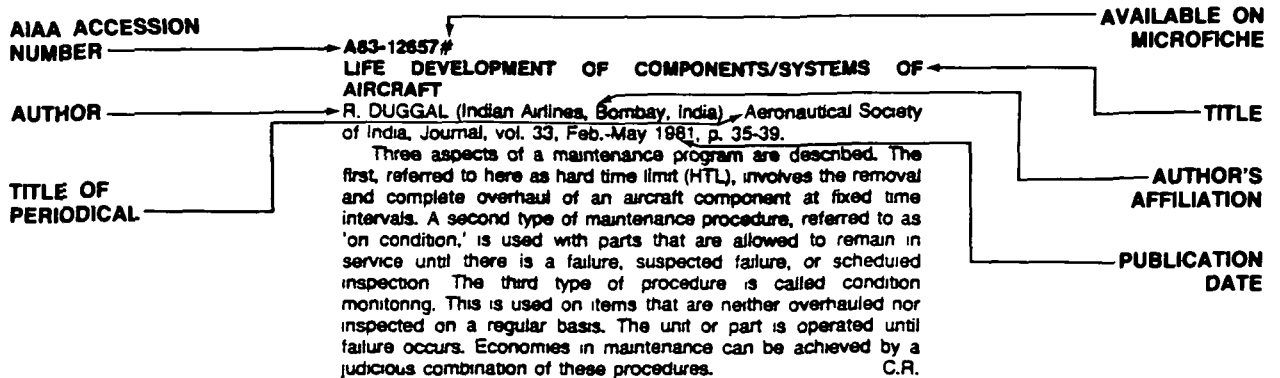
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AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 167)

NOVEMBER 1983

01

AERONAUTICS (GENERAL)

A83-41668* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATION EVALUATION OF FLIGHT CONTROLS AND DISPLAY CONCEPTS FOR VTOL SHIPBOARD OPERATIONS

G. G. FARRIS, V. K. MERRICK, and R. M. GERDES (NASA, Ames Research Center, Moffett Field, CA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 78-96. refs
(AIAA PAPER 83-2173)

A ground-based evaluation of several control-system concepts and display formats for use in shipboard landing operations of a V/STOL aircraft (AV-8A Harrier) is reported. The study was conducted in the Vertical Motion Simulator at Ames Research Center. The control systems ranged from a rate-damping SAS to a translational-velocity command system, displays ranged from a head-down presentation of attitude and altitude to two different head-up formats that provided position and velocity information. Results of pilot evaluations of the aircraft's handling qualities, as well as measures of task performance and control power use during landing on a moving deck in visual meteorological conditions, are presented. Author

A83-41947#

AN ECCENTRIC TWO-TARGET DIFFERENTIAL GAME MODEL FOR QUALITATIVE AIR-TO-AIR COMBAT ANALYSIS

J. SHINAR (Technion-Israel Institute of Technology, Haifa, Israel) and A. DAVIDOVITZ. American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 8 p. refs
(AIAA PAPER 83-2122)

An air combat duel with 'all-aspect' guided missiles between a Harrier type and a faster conventional fighter aircraft is modelled as a two-target game between a 'homicidal chauffeur' and an 'aggressive pedestrian'. The firing envelopes of the missiles are approximated by eccentric circles in the faster airplane's coordinate system. The qualitative two-target game analysis is a non-trivial combination of two zero-sum pursuit-evasion games with eccentric circular target sets. The analysis confirms the need of large 'off-boresight' angle missiles for the less maneuverable aircraft. Author

A83-42526

ANNUAL MINI-SYMPOSIUM ON AEROSPACE SCIENCE AND TECHNOLOGY, 9TH, USAF, INSTITUTE OF TECHNOLOGY, WRIGHT-PATTERSON AFB, OH, MARCH 22, 1983, PROCEEDINGS

Symposium sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1983, 310 p.

Topics in aerospace science and technology are discussed. The subjects considered include: computational aero and fluid

dynamics, flight operations and environments, flight control and space, structures and structural dynamics, composite materials, experimental facilities, applied mathematics, and bioengineering. Also addressed are: aerodynamics in alpine and nordic skiing competition, propulsion, systems engineering, vibrations, fatigue and fracture, avionics, and chemistry and physics. C.D.

A83-42546#

DESIGN, FABRICATION, AND QUALIFICATION OF COMPOSITE CARBON/EPOXY HORIZONTAL STABILIZER COMPONENTS

D. WURZEL. IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 6-8-1 to 6-8-4

For the Alpha-Jet aircraft a carbon epoxy horizontal stabilizer was developed and fabricated, which has already successfully completed its qualification tests. The structural design of the horizontal stabilizer will be presented, as will be a new one-shot manufacturing technique for its leading and trailing edges. The toolings are described and weight savings reported. Special attention was directed towards developing a composite leading edge which is not degraded in its functional capability to a greater extent than conventional aluminum leading edges by runway debris or hail impact. To verify this, extensive impact testing was conducted. Author

A83-42547#

BATTLE DAMAGE AND REPAIR OF AN ADVANCED COMPOSITE A-7 OUTER WING

J. REMAR, M. ENGLAND, and F. SANDOW (USAF, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 6-10-1 to 6-10-4.

This paper covers three ballistic tests on advanced composite A-7 outer wings while statically loaded to simulated flight loads. The purpose of this program was to provide data on the load-carrying ability of battle-damaged composite structures both unrepaired and repaired. The threats used were 12.7 mm armor piercing incendiary (API), 23 mm API, and 23 mm high explosive incendiary (HEI). All wings were loaded to simulate a 3.2 g maneuver before being impacted. The damage caused by the 12.7 mm API was repaired using a depot-level type repair and then successfully completed a 1000-hour simulated-flight fatigue test. Author

A83-42619

UNIVERSITIES - HAVE THEY A ROLE IN AERONAUTICAL RESEARCH? FLIGHT MECHANICS, AVIONICS AND SPACE

G. J. HANCOCK (Queen Mary College, London, England) Aeronautical Journal (ISSN 0001-9240), vol. 87, June-July 1983, p. 223-225.

Universities have produced mathematical models for aircraft dynamics that have provided the background for such diverse areas as flight control system development, simulator development, determination of gust loads, flight load measurements, monitoring of fatigue loads, high angle of attack departure, and active control technology. Universities have not played an influential role in flight dynamics mainly because progress in dynamics depends on direct flight experience. It is contended that a small university department

01 AERONAUTICS (GENERAL)

can be effective if it can develop at least one individual area of expertise. The importance of a forum where university specialists can discuss ideas in the context of industrial and government requirements is stressed. C.R.

A83-43025*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va

PROGRESS IN SUPERSONIC CRUISE TECHNOLOGY

C. DRIVER (NASA, Langley Research Center, Aeronautical Systems Office, Hampton, VA) NATO, AGARD, Symposium/Workshop on Sustained Supersonic Cruise and Maneuver, Brussels, Belgium, Oct. 10-13, 1983, Paper. 11 p. refs

The Supersonic Cruise Research (SCR) program identified significant improvements in the technology areas of aerodynamics, structures, propulsion, noise reduction, takeoff and landing procedures, and advanced configuration concepts. These improvements, when combined in a large supersonic cruise vehicle, offer a far greater technology advance than generally realized. They offer the promise of an advanced commercial family of aircraft which are environmentally acceptable, have flexible range-payload capability, and are economically viable. These same areas of technology have direct application to smaller advanced military aircraft and to supersonic executive aircraft. Several possible applications will be addressed. Author

A83-43030

SOVIET MILITARY AIRCRAFT AND MISSILES IN 1982 [AERONEFS ET MISSILES DES FORCES ARMEES SOVIETIQUES EN 1982]

L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 100, 1983, p. 11-28. In French.

The types, classifications, sites, and naval configurations of aircraft and missiles deployed by the Soviet Union in 1982 are inventoried, together with the ranges and capabilities of each weapon and weapon carrying system. Attention is given to the 22 fixed and variable geometry strategic aircraft and to helicopters for attack, transport, and antisubmarine warfare. Strategic missile launch sites and long-range bomber airfields are identified. It is noted that the U.S.S.R. has 7000 radar installations, in addition to satellite early warning systems. An antimissile missile system is arrayed around Moscow, and interceptor and ground-air missiles are based near the national borders for defense against attacking aircraft and cruise missiles. Tactical combat aircraft such as helicopters, as well as mobile missile launch platforms, are described, as are ship-launched aircraft and missile carrying naval vessels, with the total naval strength amounting to 1555 ships. M.S.K.

A83-43033

WORLD AERONAUTICAL RESEARCH - III [LA RECHERCHE AERONAUTIQUE DANS LE MONDE - III]

M. P. POISSON-QUINTON (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) Air et Cosmos (ISSN 0044-6971), vol 21, July 16, 1983, p. 17. In French.

Basic and applied research programs being performed by NASA and the French agency CAST are outlined. New configurations are being explored for vector thrust STOL/VTOL aircraft, maneuverable transonic aircraft, supersonic aircraft with short take-off requirements, and turbostator powered hypersonic aircraft. Studies are being performed on the engine-body, thrust-lift, thrust-braking, and wing-pylon-nacelle interactions, as well as avionics displays, the integration of computers and electric servocontrol, and flight safety. Military and civil research are combined in examinations of new propeller aircraft designs, the introduction of composite materials in turboreactors, and ceramic blades in turbines. M.S.K.

A83-43239

OPERATION OF AN AIRCRAFT ENGINE USING LIQUEFIED METHANE FUEL

J. A. RAYMER (Beech Aircraft, Corp., Boulder, CO) IN: Advances in cryogenic engineering. Volume 27 - Proceedings of the Cryogenic Engineering Conference, San Diego, CA, August 11-14, 1981. New York, Plenum Press, 1982, p. 1001-1006, Discussion, p. 1006.

In connection with the increasing prices of fuels derived from crude oil and the gradual exhaustion of petroleum resources, attention has been given to alternatives to gasoline. One of these alternatives is methane, which is currently mainly obtained for natural gas. Sources of methane which are not being used at present include coal mine gas, land fill decomposition gas, and sewage treatment gas. It is pointed out that methane has several advantages over gasoline for use in reciprocating engines. It is cleaner burning, it produces less exhaust pollution, and it can extend engine life. Other advantages are related to better cold weather starting characteristics and an equivalent octane rating of about 130. The present investigation has the objective to demonstrate the operation of a reciprocating aircraft engine on methane fuel. A liquid storage system was used. System valving was designed to deliver only liquid methane to the engine supply line. The investigation shows that the conversion of an aircraft reciprocating engine to operate on liquid methane fuel is possible with very satisfactory results. G.R.

N83-30355# General Accounting Office, Washington, D. C. Procurement, Logistics and Readiness Div.

SAVINGS CAN BE MADE BY USING COMPRESSED AIR WHEN TESTING AIRCRAFT FOR FUEL LEAKS (GAO/PLRD-83-69)

22 Apr 1983 4 p refs

(B-207202) Avail: NTIS HC A02/MF A01

The use of compressed air to test F-4 aircraft for fuel leaks is evaluated. Author

N83-30356# Naval Postgraduate School, Monterey, Calif

ECONOMIC EFFECTS OF NOISE ABATEMENT REGULATIONS ON THE HELICOPTER INDUSTRY M.S. Thesis

A. N. CONNER Dec. 1982 66 p refs

(AD-A127331) Avail: NTIS HC A04/MF A01 CSCL 01C

This thesis discusses the economic effects of noise abatement regulations on the helicopter industry. Increased manufacturing and operating costs from noise abatement regulations on Sikorsky's S-76 helicopter are estimated. The effects on consumer utilization are also discussed. An appendix compares to independent research studies that used weight estimating relationships and cost estimating relationships to estimate manufacturing costs of the helicopter by subsystem. This thesis proposes that if noise abatement for future technological improvements, helicopter manufacturers, operators of helicopter business, and consumers of helicopter services would be adversely affected. GRA

N83-30357# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

GROUND/FLIGHT TEST TECHNIQUES AND CORRELATION

Feb. 1983 535 p refs In ENGLISH; partly in FRENCH Symp. held at Cesme, Turkey, 11-14 Oct. 1982

(AGARD-CP-339; ISBN-92-835-0328-7) Avail: NTIS HC A23/MF A01

Large advances in wind tunnel and flight test instrumentation and data processing have provided better confidence in the data and, consequently, improved comparison bases. Even larger advances were made in computational aerodynamics and this has provided the basis for an efficient design tool for transport aircraft. However, in spite of all these improvements there is still a problem in providing accurate and satisfactory performance predictions. Concern was also expressed that with the increasing sophistication of test and prediction techniques, engineers may lose "track" of the physics of prediction and comparison.

N83-31569# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
THE F-4C/D LIFE EXTENSION PROGRAM Final Report, Oct. 1974 - May 1981
 R. L. SCHNEIDER Oct 1982 119 p refs
 (Contract AF PROJ 327A)
 (AD-A127495; AFWAL-TR-82-3047) Avail: NTIS HC A06/MF A01 CSDL 01C

The F-4 airframe was designed over 20 years ago for a service life of 4000 flight hours projected to be sufficient to complete the era of its usefulness in the inventory in both the USN and the USAF. However, the F-4 aircraft was slated to continue service well beyond the time when it was to have been replaced. Some 4000 F-4 aircraft are currently retained in service by the USN, USAF, and allied nations. With fatigue problems occurring in the fleet and the need for the aircraft throughout the 1980's time period, a structural integrity program was initiated to extend the life of the F-4 aircraft from 4000 hours to 8000 hours. The most comprehensive airframe fatigue test program ever conducted by the Air Force, sponsored by the Aeronautical Systems Division and the Ogden Air Logistic Center, was initiated in January 1976 by the Structures Test Branch Structures and Dynamics Division, of the Flight Dynamics Laboratory. This test program was successfully completed in April 1981 after the F-4 airframe has sustained 24,000 simulated flight hours. Actual testing and inspection accounted for only 21 months of this 63 month period, most of which was spent awaiting the design, fabrication and installation of structural modifications required to extend the service life of the F-4 aircraft. A major achievement for the test program was the physical proof that the modified structure did indeed provide the required life extension. GRA

N83-31571# Air Force Academy, Colo. Dept. of Aeronautics.
AIR FORCE ACADEMY AERONAUTICS DIGEST, SPRING/SUMMER 1982 Final Report
 J. DEJONGH, A. M. HIGGINS, J. M. KEMPF, E. J. JUMPER, and M. ARENDS Mar. 1983 167 p
 (AD-A128248, USAFA-TR-83-2) Avail: NTIS HC A08/MF A01 CSDL 01A

This Digest covers unclassified research in aeronautics performed at the United States Air Force Academy during the six months ending 15 August 1982. This report includes technical papers in the specific areas of aerodynamics, propulsion, experimental instrumentation, engineering education, and aeronautical history. Author (GRA)

N83-31573# Air Force Inst of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
EFFECT OF TEST RESULT UNCERTAINTY ON THE PERFORMANCE OF A CONTEXT-FREE TROUBLESHOOTING TASK M.S. Thesis
 H. A. BARAN 17 Dec. 1982 103 p refs
 (AD-A128584, AFIT/LSSR-86-82) Avail: NTIS HC A06/MF A01 CSDL 15E

A major problem affecting weapon system support cost and operational capability is the 20-40% troubleshooting error rate experienced by the Air Force and the Navy for all aircraft corrective maintenance actions. Most fault detection problems resemble the problem of signal detection in a background of noise, or in the case of troubleshooting, test result uncertainty. This thesis attempted to determine whether human bias exists under conditions of test result uncertainty such that troubleshooting performance is systematically affected. A knowledge of such bias might be useful in assessing the utility of powerful signal detection-in-noise analytical tools, e.g., the Relative Operating Characteristic (ROC) curve analysis, to improve predictions of troubleshooting performance, and reduce troubleshooting error by allowing man-machine troubleshooting systems to be optimized on the basis of the response characteristics of both machine and man. The experiment consisted of sixty-four subjects performing a simulated electronics troubleshooting task at four levels of test result error, zero error, 25% error, 50% good called bad error, and 50% bad called good error. Results did not indicate the existence of

significant differences in troubleshooting performance under the latter three treatment conditions; only between the first and any of the latter three. Author (GRA)

N83-31574# Management Consulting and Research, Inc., Falls Church, Va.
SUMMARY OF ANALYSIS OF SOURCES OF FORECASTING ERRORS IN BP 1500 REQUIREMENTS ESTIMATING PROCESS AND DESCRIPTION OF COMPENSATING METHODOLOGY Interim Report
 P. A. INSLEY, W. P. HUTZLER, G. R. MCNICHOLS, and G. H. WORM 25 Apr. 1982 89 p refs
 (Contract F33615-81-C-5018)
 (AD-A128548, MCR-TR-8104-3) Avail: NTIS HC A05/MF A01 CSDL 15E

The researchers developed a methodology for improving the accuracy of the Air Force Logistics Command (AFLC) forecasts of Aircraft Replenishment Spares (BP 1500) POM requirements. The research was divided into three phases: (1) Develop a program plan for accomplishing the study; (2) Examine the AFLC BP 1500 POM (Program Management Memorandum) forecasting process and identify sources of errors and recommend changes; and (3) Develop and demonstrate a methodology for improving the AFLC forecasting accuracy for BP 1500 POM requirements. GRA

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces, and internal flow in ducts and turbomachinery

A83-41052#
THE EFFECT OF DISPLACEMENT VELOCITY ON PROPELLER PERFORMANCE
 M. NISHIDA (Kyoto University, Kyoto, Japan) Journal of Aircraft (ISSN 0021-8669), vol 20, Aug 1983, p. 734-736.

The contribution of the axial displacement velocity to propeller performance was examined analytically. The axial displacement velocity is considered to augment the velocity at which the helical trailing velocity leaves the blade. The induced velocity at the helical point was calculated in terms of influence coefficients, the blade radius, a radial section, and the circulation. Determinations of the local circulation, induced velocity, and the initial location before displacement allowed iterative calculation of the displacement velocity. Sample calculations were made of the 54H60 propeller, showing that the displacement value decreases for a lightly loaded propeller. M.S.K.

A83-41206
HYPERSONIC FLOW BEHIND A LIFTING BODY [O GIPERZVUKOVOM TECHENII ZA NESUSHCHIM TELOM]
 O. S. RYZHOV and E. D. TERENCEV Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 47, May-June 1983, p. 421-427. In Russian refs

An asymptotic solution to the Navier-Stokes equations is investigated for large distances behind a lifting body of finite dimensions. The flow field is divided into three regions: the outer region, the laminar wake, and the subwake, particular attention is given to the characteristics associated with the lifting force. It is shown that the subwake, which is formed only in the presence of a lifting force, has the profile of an oscillating cord, and the gas particles in each transverse plane within the subwake are characterized by only the radial component of the velocity vector, provided the coordinate origin is selected in a special way. V.L.

A83-41266

THE MAXIMUM AERODYNAMIC EFFICIENCY OF CONICAL WING-BODY COMBINATIONS AT HIGH SUPERSONIC SPEEDS [MAKSIMAL'NOE AERODINAMICHESKOE KACHESTVO KONICHESKIKH KOMBINATSII KRYLA I KORPUSA, PRI BOL'SHIKH SVERKHZVUKOVYKH SKOROSTIAKH]

IU. I LOBANOVSII Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1983, p. 167-169. In Russian. refs

By using similarity relationships, the maximum aerodynamic efficiency and the corresponding lift coefficient in a nonviscous gas (free-stream Mach 4 or greater) are expressed as a function of two variables for several conical wing-body combinations. These include combinations of a plane, infinitely thin delta wing and a cone (symmetric configuration) or a half-cone located on the upper or the lower surface of the wing (asymmetric configurations). By solving numerically Euler equations, regions of maximum aerodynamic efficiency are obtained for the configurations studied. The effect of the gas viscosity on the shape of these regions is examined. V L

A83-41806#

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS INVOLVING PLANE TURBINE CASCADES WITH SWEEP AND DIHEDRAL [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN EBENEN TURBINENGITTERN MIT PFEILUNG UND V-STELLUNG]

H. GOTTHARDT Braunschweig, Technische Universitaet, Fakultae fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1983, 327 p. In German. refs

The present investigation aims to show that the classical assumption of axisymmetric stream surfaces is not valid in the case of turbomachines with an incoming flow direction which is inclined to the blade row axis. Such a case arises in connection with conical boundary surfaces. The investigation is also concerned with the special characteristics of the flow near the casing and the hub of the impeller of the turbomachines considered. A simplified model is developed for the representation of the geometric conditions involved, taking into account the direction of the incoming flow and the inclination of the walls to the blade row axis. Studies based on potential theory are supplemented by two- and three-dimensional boundary layer calculations according to approaches reported by Thwaites (1960), White (1974), and Dienemann (1953). A description is presented of a small cascade wind tunnel which was modified for the conduction of experimental studies related to the reported investigation. G.R.

A83-41879

INTERFERENCE DURING FLOW AROUND A WING AND AN AXISYMMETRIC NACELLE [INTERFERENTSIIA PRI OBTEKANII KRYLA I OSESIMMETRICHNOI GONDOLY]

K. IA. KOSIACHENKO (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) IN The motion of compressible fluids and inhomogeneous media. Leningrad, Izdatel'stvo Leningradskogo Universiteta, 1982, p. 11-20. In Russian.

The interference effect is examined theoretically for a model consisting of an infinitely thin delta wing with sonic leading edges, an axisymmetric nacelle, and a pylon attaching it to the wing. An integral equation is obtained in the linear formulation for the velocity potential of flow around all the aforementioned bodies in addition to a linear equation for flow only around the nacelle. The conditional-extremum problem is formulated and solved this extremum determines the optimal values of the interference parameters, assuring minimum drag of the model for a prescribed lift force in the case of the supersonic flow of an ideal gas. B.J.

A83-41902*# Douglas Aircraft Co., Inc., Long Beach, Calif. COMPUTATIONAL AERODYNAMICS APPLICATIONS TO TRANSPORT AIRCRAFT DESIGN

P. A. HENNE (Douglas Aircraft Co., Long Beach, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 14 p. Research supported by the McDonnell Douglas Independent Research and Development Program. refs (Contract NAS1-15327) (AIAA PAPER 83-2061)

Examples are cited in assessing the effect that computational aerodynamics has had on the design of transport aircraft. The application of computational potential flow methods to wing design and to high-lift system design is discussed. The benefits offered by computational aerodynamics in reducing design cost, time, and risk are shown to be substantial. These aerodynamic methods have proved to be particularly effective in exposing inferior or poor aerodynamic designs. Particular attention is given to wing design, where the results have been dramatic. C R

A83-41912*# Old Dominion Univ., Norfolk, Va.

COMPUTATIONAL TECHNIQUE FOR THREE-DIMENSIONAL COMPRESSIBLE FLOW PAST WINGS AT HIGH ANGLES OF ATTACK

O. A. KANDIL (Old Dominion University, Norfolk, VA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 10 p. refs (Contract NSG-1560) (AIAA PAPER 83-2078)

A computational technique, based on the integral solution of the full potential equation, has been developed for the solution of three-dimensional high-subsonic flows past wings at high angles of attack. The problem includes two sources of nonlinearities: a boundary oriented nonlinearity (separated flow roll up) and a region oriented nonlinearity (flow compressibility). The former is represented by a nonlinear vortex lattice while the latter is represented by a source distribution inside a finite volume. The solution is obtained by using double iteration cycles, a separated flow (wake) iteration cycle and a compressibility iteration cycle. The computational technique is applied to a delta wing. The results show that the technique is very promising and efficient. Author

A83-41913#

COMPUTATIONAL METHOD OF THE DRAG OF AXISYMMETRIC AFTERBODIES IN SUBSONIC FLOW

M. KADRY (Military Technical College, Cairo, Egypt) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 10 p. refs (AIAA PAPER 83-2079)

A theoretical and experimental study is performed in order to establish a computational method of the drag of axisymmetric afterbodies (base + boattail) in subsonic compressible flow at zero incidence. The afterbody drag is considered in the framework of a global treatment of the body total drag, accordingly, no constraints are imposed on the distance between the nose and the afterbody. This method is based on the formulation of two independent relations between body total drag and base pressure. The first relation results from the analysis of pressure and shear forces distribution on the body surface while the second stems from the analysis of the near and far wake. Satisfactory agreement is obtained between calculated results and drag measurements conducted on afterbodies of different meridians and closure ratios. Author

A83-41940#

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE SUBSONIC AERODYNAMICS OF SLENDER WINGS WITH LEADING-EDGE VORTEX FLAPS

G. E. ERICKSON and M. K. MCCANN (Northrop Corp., Aircraft Div., Hawthorne, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 23 p. refs (AIAA PAPER 83-2113)

Low-speed wind tunnel test data on a 65-degree cropped delta wing-body configuration reveal a significant reduction in drag at moderate-to-high lift owing to the deflection of a gothic-shaped vortex flap. Subsequent wing upper surface flow visualization in wind tunnel and water tunnel facilities shows a favorable interaction phenomenon of a two-primary-vortex system. The vortex interaction persists, and additional large reductions in drag are achieved, with deflection of a plain trailing-edge flap. Upward deflection of the gothic vortex flap produces large vortex-lift increments at typical approach angles of attack. The experimental results compare favorably with theoretical estimates from the extended NASA Langley Vortex Lattice Method with Suction Analogy. Test data obtained on a 70/50-degree cranked wing-body configuration reveal less significant reductions in drag owing to the deflection of a two-segment vortex flap. C R

A83-41941#

AN INVESTIGATION OF THE BREAKDOWN OF THE LEADING EDGE VORTICES ON A DELTA WING AT HIGH ANGLES OF ATTACK

J. F. MCKERNAN and R. C. NELSON (Notre Dame, University, Notre Dame, IN) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 10 p. refs (AIAA PAPER 83-2114)

An investigation of the breakdown of the leading edge vortices that form on delta wings at high angles of attack is presented. A laser illumination technique was used for flow visualization. Pictures were taken at 1/4-, mid-, and 3/4-chord positions for sideslip angles of 0, -4, and -8 degrees at 10 different angles of attack from 0 to 45 degrees in increments of 5 degrees. In addition to obtaining this series of quality photographs, the structure of the vortices and the progression of the burst point as a function of angle of attack and sideslip angle was studied. Surface pressure measurements yielded lift, pitching moment, and rolling moment curves as functions of angle of attack and sideslip angle. Plots of pressure coefficients across the span at various chord locations, sideslip angles, and incidence angles are also presented. Author

A83-41953#

MOTION OF AIRCRAFT TRAILING VORTICES NEAR THE GROUND

M. ATIAS and D. WEIHS (Technion-Israel Institute of Technology, Haifa, Israel) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 7 p. refs (AIAA PAPER 83-2130)

A theoretical study of the motion of a two-dimensional vortex pair, such as obtained in a subsonic aircraft wake moving near the ground is described. The wake motion, analysed by a discrete vortex method, is shown to be characterized by a repeating rebounding phenomenon, resulting in a spiral path, with a general upward and outward motion, after the initial approach to the ground. It is shown that the cause of the rebounding and the oscillations observed in the trajectories of such vortex pairs is the boundary layer generated near the ground. This vorticity separates and gyrates around the vortices of the pair. Author

A83-41954#

TRANSONIC WIND TUNNEL TEST ON AN OSCILLATING FLAP

S. L. STARGILL (Lockheed-Georgia Co., Marietta, GA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 7 p. (AIAA PAPER 83-2132)

Flutter tests on supercritical wings have indicated a pronounced transonic dip in the dynamic pressure flutter boundary. There is a need for further tests and studies to fully explain the unsteady aerodynamic phenomena that are occurring at and near the wing flutter condition. Tests were conducted in the Lockheed-Georgia transonic blowdown tunnel at Mach numbers up to 0.75 and at Reynolds numbers up to 11×10^6 to the 6th. Maximum reduced frequency was 0.3 at the drag rise Mach number. Tunnel wall porosity was varied from zero to 10 percent, and some tests were repeated with the perforated tunnel walls covered with gauze to reduce the tunnel generated noise level. The unsteady aerodynamic chordwise pressure distributions were determined from the measured data, and the control effectiveness of the flaps for flutter suppression was assessed. Author

A83-41957*# Bihrie Applied Research, Inc., Jericho, N. Y.

INFLUENCE OF AIRPLANE COMPONENTS ON ROTATIONAL AERODYNAMIC DATA FOR A TYPICAL SINGLE-ENGINE AIRPLANE

J. RALSON (Bihrie Applied Research, Inc., Jericho, NY) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 10 p. (Contract NAS1-16205) (AIAA PAPER 83-2135)

The influence of airplane components, as well as wing location and tail length, on the rotational flow aerodynamics is discussed for a 1/6-scale general aviation airplane model. Examination of the individual component effects provides insight as to the source of the moment and forces that determine spin characteristics. For the subject airplane, it is seen that the presence of the horizontal tail adversely effects the yaw damping of the vertical tail such that at certain angles of attack the vertical actually becomes a propelling component in spinning motion. It is shown that the level of this adverse interaction is a function of the relative positions of the wing and the tail surfaces, e.g., relocating the wing to the high wing position or shortening the tail moment arm from the basic configuration both reduced or eliminated the adverse tail interference for certain angles of attack. The influence of wing location on the damping characteristics of the horizontal-vertical tail combination would not be addressed in any existing tail design criterion for spinning and could only be discerned through rotary balance testing. Author

A83-42100*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL RESULTS OF A DEFLECTED THRUST V/STOL NOZZLE RESEARCH PROGRAM

P. L. BURSTADT and A. L. JOHNS (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Conference, 21st, Reno, NV, Jan. 10-13, 1983. 25 p. refs (AIAA PAPER 83-0170)

Four deflected thrust nozzle concepts, designed to operate at the low pressure ratio typical of high bypass-ratio turbofan engines for medium speed (subsonic) V/STOL aircraft, were studied. Maps of overall performance characteristics and exit velocity distributions are used to highlight similarities and differences between the four concepts. Analytically determined secondary flows at the exit of a 90 deg circular pipe bend are compared with the experimental results from the more complex three dimensional geometries. The relative impact of total-pressure losses and secondary flows on nozzle thrust coefficient is addressed by numerical integration of exit velocity measurements. Previously announced in STAR as N83-25657. Author

A83-42536#

THEORETICAL GUST RESPONSE PREDICTION OF A JOUKOWSKI AIRFOIL

R. G. DOCKEN, JR., E. J. JUMPER, and J. E. HITCHCOCK (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 3-2-1 to 3-2-3. refs

An analytical study into the gust response of an airfoil is presented. The momentum-integral equation for steady flows is extended into the unsteady flow regime to predict the behavior of an airfoil that experiences a constant-rate-of-change of angle-of-attack gust. The von Karman-Pohlhausen method of integration is successfully modified to incorporate the additional transient flow terms; the equation of closure necessary to do this is also presented. Finally, computation of the flow about a Joukowski airfoil using the new equations is performed and the results are presented and discussed. It will be shown that these results are in agreement with existing experimental data. Author

A83-42537#

CIRCULATION-CONTROLLED ELLIPTICAL AIRFOIL

J. K. HARVELL and M. E. FRANKE (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 3-9-1, 3-9-2. refs

Circulation control has been considered for a number of years for use in helicopter rotors and for improving STOL performance of conventional aircraft. The aerodynamic characteristics of a cambered elliptical airfoil with blown jets on the blunt trailing edge are described. Spanwise jet slots are designed so that the jets are tangential to the blunt rear surface of the airfoil. The Coanda effect allows the jet flow to remain attached to the blunt curved surface, which results in increased airfoil circulation and lift. The airfoil lift coefficient is shown to increase as blowing is increased. Author

A83-42560#

THE RULE OF FORBIDDEN SIGNALS AND APPARENT MACH NUMBERS IN SUPERSONIC COMPRESSOR CASCADES

D. C. PRINCE, JR. (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 13-4-1 to 13-4-4. refs

Experimental data for flows in supersonic compressor rotors and two-dimensional supersonic compressor cascade tests are presented which show that the flows respect the rule of forbidden signals. Pressure signals from downstream do not penetrate through regions of local supersonic flow. Appearances and disappearances of shock waves suggest interpretations as reduced 'apparent Mach numbers'. A straightforward method of characteristics analysis provides good predictions of measured static pressures and wave patterns for the cascade test data. There is progress at correlating details of the rotor measurements with design features and analytical expectations, but much more needs to be done. Author

A83-42621

UNIVERSITIES - HAVE THEY A ROLE IN AERONAUTICAL RESEARCH? AERODYNAMICS

L. C. SQUIRE (Cambridge University, Cambridge, England) Aeronautical Journal (ISSN 0001-9240), vol. 87, June-July 1983, p. 229-232.

Attention is given to developments in wind tunnel design, work in turbomachinery, and turbulence modeling. The small pilot tunnel designed by Goodyear at Southampton is described. This tunnel has flexible top and bottom walls controlled by means of a series of jacks. In a test, the pressures on the inside of the tunnel walls, along with their shapes, are measured. An imaginary flow around the wall shape is then calculated, and the walls adjusted until the

measured pressures on the inside and the calculated pressures on the outside of the walls match, in which case the walls follow a streamline. Results in a very small tunnel can thus be obtained which are in good agreement with those obtained in large industrial tunnels. High Reynolds numbers can also be achieved by running the tunnel at low temperatures. A short-duration cascade tunnel designed by Schultz at Oxford is then described. The approach to turbulence modeling adopted in the universities in the UK is illustrated by describing the work of Bradshaw at Imperial College. C.R.

A83-43318

THE CALCULATION OF TWO-DIMENSIONAL TRANSONIC FLOW OVER AEROFOILS INCLUDING BOUNDARY LAYER AND WAKE EFFECTS

P. BANSOD and T. PHAM (Canadair, Ltd., Montreal, Canada) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 14 p. Research supported by Canadair, Ltd., Department of Industry, Trade and Commerce of Canada. refs

(Contract DITC-14ST67-023-08-0186; DITC-9ST79-00040) (SAE PAPER 830708)

A brief description is given of the development of a weak interaction method for calculating transonic flows over aerofoils. Viscous effects are introduced by changing the boundary conditions on the aerofoil surface and wake. The wake thickness and curvature are taken into account. The method is evaluated against experimental data for eight aerofoils with sharp and thick trailing edges. Comparisons between experiment and theory are presented for turbulent boundary layer parameters, pressure distribution and drag. Author

A83-43319* Beech Aircraft Corp., Wichita, Kans

STUDIES OF LIGHT-TWIN WING-BODY INTERFERENCE

W. G. THOMSON (Beech Aircraft Corp., Wichita, KS) and W. H. WENTZ, JR. (Wichita State University, Wichita, KS) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 7 p. Research supported by the Beech Aircraft Corp. and NASA.

(SAE PAPER 830709)

The results of an analytical study of aerodynamic interference effects for a light twin aircraft are presented. The data presented concentrates on the influence of a wing on a body (the fuselage). Wind tunnel comparisons of three fillets are included, with corresponding computational analysis. Results indicate that potential flow analysis is useful to guide the design of intersection fairings, but experimental tuning is still required. While the study specifically addresses a light twin aircraft, the methods are applicable to a wide variety of aircraft. Author

A83-43329* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NASA WAKE INTERACTIONS RESEARCH AND APPLICATIONS

D. J. MORRIS, C. C. CROOM, B. J. HOLMES (NASA, Langley Research Center, Hampton, VA), and C. P. VAN DAM (National Research Council, Washington, DC) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 12 p. refs

(SAE PAPER 830764)

This report describes the development, validation, and application of a computer program for predicting trajectories and ground deposit patterns for particle released in the wakes of airplanes or helicopters. The computer program accounts for the effects of atmospheric turbulence, crosswind, propeller slipstream, terrain variations, evaporation, and plant canopy density on the particle trajectories. In order to validate the prediction method, some comparisons are shown between experimental data and theoretical predictions. Possible applications of the code for spray pattern improvement and for mission operations analysis are illustrated. In addition, the effect of winglets on pattern uniformity, drift, and airplane aerodynamics are presented. Author

A83-43443*# Lockheed-Georgia Co., Marietta.
A GRID OVERLAPPING SCHEME FOR FLOWFIELD
COMPUTATIONS ABOUT MULTICOMPONENT
CONFIGURATIONS

E. H. ATTA and J. VADYAK (Lockheed-Georgia Co., Advanced Flight Sciences Dept., Marietta, GA) AIAA Journal (ISSN 0001-1452), vol. 21, Sept. 1983, p. 1271-1277 Research supported by the Lockheed-Georgia Co refs (Contract NAS2-11285)

Previously cited in issue 18, p. 2841, Accession no A82-37477

A83-43454#
THE TWO-DIMENSIONAL LAMINAR WAKE WITH INITIAL
ASYMMETRY

A. DEMETRIADES (Montana State University, Bozeman, MT) AIAA Journal (ISSN 0001-1452), vol. 21, Sept. 1983, p. 1347-1349 Research supported by the TETRA Corp. refs (Contract F44620-75-C-0016, F49620-79-C-0210)

A problem frequently encountered in laser cavity flows, airfoil aerodynamics, and similar two-dimensional fluid problems has to do with the mixing of two identical uniform compressible streams past the sharp trailing edge of a partition having a laminar boundary layer thicker on one side than on the other. This configuration resembles an ordinary two-dimensional wake in that the streams are identical, the disparity in the boundary-layer thicknesses, however, is bound to introduce asymmetries in the flow, especially beyond but near the trailing edge. The distance beyond the trailing edge over which such asymmetries persist has significance, especially if no restrictions are placed on the flow Mach number and the ratio of the temperature of the solid partition to the stagnation temperature of the stream. Formulas are presented here which are valid for such an asymmetric wake for any Mach number and temperature ratio and any degree of asymmetry introduced by the ratio $\theta(1)/\theta(2)$, where θ is the boundary-layer momentum thickness at the trailing edge and the numbers 1 and 2 refer to the two sides of the partition C.R

A83-43522
FLOW IN A HYPERSONIC BOUNDARY LAYER ON A DELTA
WING OF FINITE LENGTH AT ANGLE OF ATTACK [TECHENIE
V GIPERZVUKOVOM POGRANICHNOM SLOE NA
TREUGOL'NOM KRYLE KONECHNOI DLINY PRI NALICHII
UGLA ATAKI]

G. N. DUBIN PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), May-June 1983, p. 108-113 In Russian refs

Hypersonic flow of viscous gas around a delta wing of finite length at angle of attack is analyzed under conditions of strong viscous interaction. It is assumed that the perturbed part of the flow includes nonviscous flow, which can be described in terms of the hypersonic theory of small perturbations, and a viscous boundary layer. The problem is reduced to a system of partial differential equations which are solved using the finite-difference method. An illustrative example is given V.L

N83-30383# Societe Nationale Industrielle Aerospatiale, Paris
(France)

HELICOPTER AIR INLETS: DESIGN PROCESS, WIND TUNNEL
TESTING AND CORRELATIONS WITH FLIGHT DATA

F. TOULMAY In AGARD Ground/Flight Test Tech. and Correlation 23 p Feb. 1983 refs In FRENCH; ENGLISH summary

Avail: NTIS HC A23/MF A01

Major inlet design problems of helicopter engines and ways of solving them through down-scaled models are discussed. Pressure loss, dynamic pressure recovery, pressure distortion, hot air re-ingestion, external drag, and constraints due to engine and/or aircraft architecture are among the topics discussed. Indications are given concerning the selection of model parameters, test procedure and real-time processing R.J.F.

N83-30384# Royal Aircraft Establishment, Farnborough
(England)

SYNTHESIS OF RESPONSES TO AGARD-FMP QUESTIONNAIRE
ON "PREDICTION TECHNIQUES AND FLIGHT
CORRELATION"

J. WILLIAMS In AGARD Ground/Flight Test Tech. and Correlation 30 p Feb. 1983

Avail: NTIS HC A23/MF A01

Correlation between flight results and wind tunnel, analytical prediction, free-flight model, and simulation methods, for performance, flying qualities, aeroelastic effects and subsystems such as store separation and inlets is discussed. The results of a survey of flight correlation and prediction techniques are given

R.J.F.

N83-30385*# Old Dominion Univ., Norfolk, Va
NUMERICAL OPTIMIZATION TECHNIQUES FOR BOUND
CIRCULATION DISTRIBUTION FOR MINIMUM INDUCED DRAG
OF NONPLANAR WINGS: COMPUTER PROGRAM
DOCUMENTATION **Topical Report, Mar. - Sep. 1979**

J. M. KUHLMAN and T. J. KU Washington NASA Aug 1981 79 p refs

(Contract NSG-1357)

(NASA-CR-3458; NAS 1.26 3458) Avail: NTIS HC A05/MF A01 CSCL 01A

A two dimensional advanced panel far-field potential flow model of the undistorted, interacting wakes of multiple lifting surfaces was developed which allows the determination of the spanwise bound circulation distribution required for minimum induced drag. This model was implemented in a FORTRAN computer program, the use of which is documented in this report. The nonplanar wakes are broken up into variable sized, flat panels, as chosen by the user. The wake vortex sheet strength is assumed to vary linearly over each of these panels, resulting in a quadratic variation of bound circulation. Panels are infinite in the streamwise direction. The theory is briefly summarized herein, sample results are given for multiple, nonplanar, lifting surfaces, and the use of the computer program is detailed in the appendixes Author

N83-30386*# National Aeronautics and Space Administration
Langley Research Center, Hampton, Va.

DESIGN AND EXPERIMENTAL RESULTS FOR A FLAPPED
NATURAL-LAMINAR-FLOW AIRFOIL FOR GENERAL AVIATION
APPLICATIONS

D. M. SOMERS Jun 1981 125 p refs

(NASA-TP-1865; L-14409, NAS 1.60:1865) Avail: NTIS HC A06/MF A01 CSCL 01A

A flapped natural laminar flow airfoil for general aviation applications, the NLF(1)-0215F, has been designed and analyzed theoretically and verified experimentally in the Langley Low Turbulence Pressure Tunnel. The basic objective of combining the high maximum lift of the NASA low speed airfoils with the low cruise drag of the NACA 6 series airfoils has been achieved. The safety requirement that the maximum lift coefficient not be significantly affected with transition fixed near the leading edge has also been met. Comparisons of the theoretical and experimental results show generally good agreement Author

N83-30387*# Kohlman Aviation Corp., Lawrence, Kans
CALCULATION OF LATERAL-DIRECTIONAL STABILITY
DERIVATIVES OF WINGS BY A NONPLANAR
QUASI-VORTEX-LATTICE METHOD

C. E. LAN Jan 1981 135 p refs

(NASA-CR-165659, NAS 1.26:165659, REPT-80-001) Avail: NTIS HC A07/MF A01 CSCL 01C

The nonplanar quasi-vortex-lattice method is applied to the calculation of lateral-directional stability derivatives of wings with and without vortex-lift effect. Results for conventional configurations and those with winglets, V-tail, etc. are compared with available data. All rolling moment derivatives are found to be accurately predicted. The prediction of side force and yawing moment derivatives for some configurations is not as accurate. Causes of

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the discrepancy are discussed. A user's manual for the program and the program listing are also included. Author

N83-30388*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INTERACTIVE INPUT FOR THE QUICK GEOMETRY SYSTEM: USER'S MANUAL

M S ADAMS Feb. 1981 67 p
(NASA-TM-81933; NAS 1.15.81933) Avail: NTIS HC A04/MF A01 CSCL 01A

An interactive graphics computer program was developed to create the QUICK-Geometry input definition of a model, from a set of discrete coordinate data (point description). The necessary information to access and execute the programs is included. In general, the program displays the input coordinate data and allows the user to interactively and iteratively select the analytic QUICK curves and match them visually to the coordinate data. The curve drawing subroutines are identical to those used by the QUICK geometry processor, assuring that the analytic representations will be properly interpreted. Author

N83-30389*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EXPERIMENTAL INVESTIGATION OF A 10-PERCENT-THICK HELICOPTER ROTOR AIRFOIL SECTION DESIGNED WITH A VISCOUS TRANSONIC ANALYSIS CODE

K. W. NOONAN Jul 1981 78 p refs
(Contract DA PROJ. 1L1-61102-AH-45)
(NASA-TP-1864, L-14182; NAS 1.60.1864;
AVRADCOM-TR-81-B-3) Avail: NTIS HC A05/MF A01 CSCL 01A

An investigation was conducted in the Langley 6- by 28-Inch Transonic Tunnel to determine the two dimensional aerodynamic characteristics of a 10-percent-thick helicopter rotor airfoil at Mach numbers from 0.33 to 0.87 and respective Reynolds numbers from 4.9×10 to the 6th to 9.8×10 to the 6th. This airfoil, designated the RC-10(N)-1, was also investigated at Reynolds numbers from 3.0×10 to the 6th to 7.3×10 to the 6th at respective Mach numbers of 0.33 to 0.83 for comparison with the SC 1095 (with tab) airfoil. The RC-10(N)-1 airfoil was designed by the use of a viscous transonic analysis code. The results of the investigation indicate that the RC-10(N)-1 airfoil met all the design goals. At a Reynolds number of about 9.4×10 to the 6th the drag divergence Mach number at zero normal-force coefficient was 0.815 with a corresponding pitching-moment coefficient of zero. The drag divergence Mach number at a normal-force coefficient of 0.9 and a Reynolds number of about 8.0×10 to the 6th was 0.61. The drag divergence Mach number of this new airfoil was higher than that of the SC 1095 airfoil at normal-force coefficients above 0.3. Measurements in the same wind tunnel at comparable Reynolds numbers indicated that the maximum normal-force coefficient of the RC-10(N)-1 airfoil was higher than that of the NACA 0012 airfoil for Mach numbers above about 0.35 and was about the same as that of the SC 1095 airfoil for Mach numbers up to 0.5. Author

N83-30390*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LOW-SPEED AERODYNAMIC PERFORMANCE OF AN ASPECT-RATIO-10 SUPERCRITICAL-WING TRANSPORT MODEL EQUIPPED WITH A FULL-SPAN SLAT AND PART-SPAN AND FULL-SPAN DOUBLE-SLOTTED FLAPS

H. L. MORGAN, JR Apr. 1981 183 p refs
(NASA-TP-1805; L-13825; NAS 1.60.1805) Avail: NTIS HC A09/MF A01 CSCL 01A

An investigation was conducted in the Langley 4 by 7 Meter Tunnel to determine the static longitudinal and lateral directional aerodynamic characteristics of an advanced aspect ratio 10 supercritical wing transport model equipped with a full span leading edge slat as well as part span and full span trailing edge flaps. This wide body transport model was also equipped with spoiler and aileron roll control surfaces, flow through nacelles, landing gear, and movable horizontal tails. Six basic wing configurations

were tested: (1) cruise (slats and flaps nested), (2) climb (slats deflected and flaps nested), (3) part span flap, (4) full span flap, (5) full span flap with low speed ailerons, and (6) full span flap with high speed ailerons. Each of the four flapped wing configurations was tested with leading edge slat and trailing edge flaps deflected to settings representative of both take off and landing conditions. Tests were conducted at free stream conditions corresponding to Reynolds number of 0.97 to 1.63×10 to the 6th power and corresponding Mach numbers of 0.12 to 0.20, through an angle of attack range of 4 to 24, and a sideslip angle range of -10 deg to 5 deg. The part and full span wing configurations were also tested in ground proximity. Author

N83-30391*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

WALL-TEMPERATURE EFFECTS ON THE AERODYNAMICS OF A HYDROGEN-FUELED TRANSPORT CONCEPT IN MACH 8 BLOWDOWN AND SHOCK TUNNELS

J. A. PENLAND, D. C. MARCUM, JR., and S. H. STACK Jul. 1983 61 p refs
(NASA-TP-2159, L-15100; NAS 1.60.2159) Avail: NTIS HC A04/MF A01 CSCL 01A

Results are presented from two separate tests on the same blended wing-body hydrogen fueled transport model at a Mach number of about 8 and a range of Reynolds numbers (based on theoretical body length) of 0.597×10 to the 6th power to about 156.22×10 to the 6th power. Tests were made in conventional hypersonic blowdown tunnel and a hypersonic shock tunnel at angles of attack of -2 deg to about 8 deg, with an extensive study made at a constant angle of attack of 3 deg. The model boundary-layer flow varied from laminar at the lower Reynolds numbers to predominantly turbulent at the higher Reynolds numbers. Model wall temperatures and stream static temperatures varied widely between the two tests, particularly at the lower Reynolds numbers. These temperature differences resulted in marked variations of the axial-force coefficients between the two tests, due in part to the effects of induced pressure and viscous interaction variations. The normal-force coefficient was essentially independent of Reynolds number. Analysis of results utilized current theoretical computer programs and basic boundary-layer theory. Author

N83-30394*# National Aeronautics and Space Administration, Washington, D. C.

RAIN AND DEICING EXPERIMENTS IN A WIND TUNNEL

G. FASSO Jun. 1983 13 p Transl. into ENGLISH of conf. paper presented at the 8th Congr. Intern. Aeronautique, 1967 p 1-14. Congr. held in Paris, 29-31 May 1967. Original language document was announced as A68-38546. Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASW-3542)
(NASA-TM-77077; NAS 1.15:77077) Avail: NTIS HC A02/MF A01 CSCL 01A

Comments on films of tests simulating rain and ice conditions in a wind tunnel are presented, with the aim of studying efficient methods of overcoming the adverse effects of rain and ice on aircraft. In the experiments, lifesize models and models of the Mirave 4 aircraft were used. The equipment used to simulate rain and ice is described. Different configurations of landing and takeoff under conditions of moderate or heavy rain at variable angles of incidence and of skipping and at velocities varying from 30 to 130 m/sec are reproduced in the wind tunnel. The risks of erosion of supersonic aircraft by the rain during the loitering and approach phases are discussed. S. L.

N83-30395# Midwest Research Inst., Golden, Colo. Renewable Resource Assessment and Instrumentation Branch.

WINDMILL WAKE TURBULENCE DECAY: A PRELIMINARY THEORETICAL MODEL

E. A. BOSSANYI Feb. 1983 31 p refs

(Contract DE-AC02-77CH-00178, EG-77-C-01-4042)

(DE83-008162; SERI/TR-635-1280) Avail: NTIS HC A03/MF A01

The results are given of initial theoretical attempts to predict dynamic wake characteristics, particularly turbulence decay, downstream of wind turbine generators in order to assess the potential for acoustic noise generation in clusters or arrays of turbines. These results must be considered preliminary, because the model described is at least partially based on the assumption of isotropy in the turbine wakes, however, an isotropic conditions may actually exist, particularly in the near-wake regions. The results indicate that some excess spectral energy may still exist. The turbine-generated turbulence from one machine can reach the next machine in the cluster and, depending on the turbulent wavelengths critical for acoustic noise production and perhaps structural excitation, this may be a cause for concern. Such a situation is most likely to occur in the evening or morning, during the transition from the daytime to the nocturnal boundary layer and vice-versa, particularly at more elevated sites where the winds tend to increase after dark.

DOE

N83-30396# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

THE EVALUATION OF SOME COLLISION MODELS USED FOR MONTE-CARLO CALCULATIONS OF DIATOMIC RAREFIED HYPERSONIC FLOWS

J. DAVIS, R. G. DOMINY, J. K. HARVEY, and M. N. MACROSSAN Dec. 1982 29 p refs

(IC-AERO-82-03; ISSN-0308-7247) Avail: NTIS HC A03/MF A01

Intermolecular collision models used in Monte-Carlo direct simulation computations were assessed by comparing the predictions given for two contrasting flows with experimental results. In one flow viscous effects were predominant, in the other the rapid compression ahead of a blunt body was the feature concentrated upon. In both examples the flows were rarefied and hypersonic and the gas was diatomic and rotationally excited. Because of its theoretical and demonstrated versatility the Morse potential combined with the variable ϕ energy exchange is recommended as a general purpose collision model.

Author (ESA)

N83-30397# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

HEAT TRANSFER AND SKIN FRICTION MEASUREMENTS IN A HYPERSONIC TURBULENT BOUNDARY LAYER AT $M = 9$

A. J. EDWARDS and R. HILLIER Aug 1982 43 p refs

(Contract MOD-AT/2037/084)

(IC-AERO-82-04; ISSN-0308-7247) Avail: NTIS HC A03/MF A01

Surface heat transfer and skin friction measurements in a two dimensional flat plate hypersonic turbulent boundary layer with natural transition is described. Both high and low Reynolds number conditions were used in the wind tunnel test, and a free stream temperature of 58 K was employed. Comparisons between the heat transfer results and theories show the lack of an adequate boundary layer prediction method under these conditions. The values for the skin friction deduced from Preston tube measurements, from velocity profiles and from heat transfer measurements are compared, highlighting the need for more detailed work on the direct measurement of skin friction.

Author (ESA)

N83-31576*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Aerospace and Ocean Engineering.

AN EXPERIMENTAL STUDY OF PRESSURES ON 60 DEG DELTA WINGS WITH LEADING EDGE VORTEX FLAPS Final Report

J. F. MARCHMAN, III, J. E. TERRY, and D. A. DONATELLI 30 Jun 1983 121 p refs

(Contract NAG1-274)

(NASA-CR-172833; NAS 1 26 172833) Avail: NTIS HC A06/MF A01 CSCL 01A

An experimental study was conducted in the Virginia Tech Stability Wind Tunnel to determine surface pressures over a 60 deg sweep delta wing with three vortex flap designs. Extensive pressure data was collected to provide a base data set for comparison with computational design codes and to allow a better understanding of the flow over vortex flaps. The results indicated that vortex flaps can be designed which will contain the leading edge vortex with no spillage onto the wing upper surface. However, the tests also showed that flaps designed without accounting for flap thickness will not be optimum and the result can be oversized flaps, early flap vortex reattachment and a second separation and vortex at the wing/flap hinge line.

Author

N83-31577*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

WIND-TUNNEL INVESTIGATION OF LEADING-EDGE THRUST ON ARROW WINGS IN SUPERSONIC FLOW

R. J. MACK Aug 1983 80 p refs

(NASA-TP-2167, L-15535, NAS 1.60 2167) Avail: NTIS HC A05/MF A01 CSCL 01A

Six wing models were tested in the Langley Unitary Plan Wind Tunnel to identify and study leading-edge thrust at supersonic speeds. The tests were conducted at Mach numbers of 1.6, 1.8, 2.0, and 2.16, at a stagnation temperature of 1250 F, and at Reynolds numbers per foot of 2.0×10^6 to the 6th power and 5.0×10^6 to the 6th power. Test results showed that significant benefits from leading-edge thrust and nonlinear thickness effects can be obtained with very little airfoil bluntness, that these benefits were lost when the airfoil was severely blunted, and that such benefits seem to be found on wings with supersonic as well as subsonic leading edges.

Author

N83-31578*# Informatics General Corp., Palo Alto, Calif.

IMPROVED METHOD FOR TRANSONIC AIRFOIL DESIGN-BY-OPTIMIZATION

R. A. KENNELLY, JR. Jun 1983 14 p refs

(Contract NAS2-11555)

(NASA-CR-166497, NAS 1.26 166497, TN-11555-307-8) Avail: NTIS HC A02/MF A01 CSCL 01A

An improved method for use of optimization techniques in transonic airfoil design is demonstrated. FLO6QNM incorporates a modified quasi-Newton optimization package, and is shown to be more reliable and efficient than the method developed previously at NASA-Ames, which used the COPES/CONMIN optimization program. The design codes are compared on a series of test cases with known solutions, and the effects of problem scaling, proximity of initial point to solution, and objective function precision are studied. In contrast to the older method, well-converged solutions are shown to be attainable in the context of engineering design using computational fluid dynamics tools, a new result. The improvements are due to better performance by the optimization routine and to the use of problem-adaptive finite difference step sizes for gradient evaluation.

Author

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N83-31579*# National Aeronautics and Space Administration, Washington, D. C.

CONTRIBUTION TO THE AERODYNAMIC STUDY OF WINGS AND PROPELLERS

M. MENARD Jun 1983 80 p refs Transl into ENGLISH of "Contribution a l'Etude Aerodynamique de l'Aile et de l'Helice" rept. Publ. Sci. et Tech. 262 Ministere de l'Air, Inst Aerotechnique de Saint-Cyr, Paris, 1952 p 1-61 Transl. by Scientific Translations Service, Santa Barbara, Calif.

(Contract NASW-3542)

(NASA-TM-77083; NAS 1.15:77083) Avail: NTIS HC A05/MF A01 CSCL 01A

Various problems regarding the aerodynamics of lifting wings are solved. Two methods are proposed for replacing the wing, both involving 'viscous' edge vortices the applications give results which agree well with experiments. Two new methods are also proposed for calculating propellers based on the vortex model consisting of an edge vortex and a 'viscous' hub vortex. Author

N83-31580# McDonnell-Douglas Automation Co., St. Louis, Mo. **INVESTIGATION OF LIMIT CYCLE RESPONSE OF AERODYNAMIC SURFACES WITH STRUCTURAL NONLINEARITIES Final Report, 1 Apr. - 31 Oct. 1982**

R. P. BRILEY and J. L. GUBSER 1 Oct. 1983 65 p refs (Contract F49620-82-C-0043, AF PROJ 2307)

(AD-A127140, AFOSR-83-0232TR) Avail: NTIS HC A04/MF A01 CSCL 20D

Aerodynamic surface design must often account for the presence of structural nonlinearities induced by freeplay in the support structure and/or control actuators. During this study, application of asymptotic expansion methods to predict the limit cycle behavior of aerodynamic surfaces with; structural nonlinearities was investigated. Two basic types of nonlinearities, freeplay and preload, were introduced at the aerosurface support structure and the resulting limit cycle behavior analyzed. The asymptotic expansion method was used to derive a relationship between the parameters characterizing the structural nonlinearity and the amplitude and frequency of the limit cycle response. The results of this investigation show that the asymptotic solutions accurately predict the stationary limit cycle behavior when compared with numerical simulation and describing-function analyses for the nonlinearities considered. The influence of higher harmonics on the predicted limit cycle response were also observed when higher order perturbation solutions were obtained. This study demonstrates the applicability of the asymptotic expansion method in accounting for the influence of structural nonlinearities in the limit cycle analysis of aerodynamic surfaces. GRA

N83-31582# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Analysis and Optimization Branch.

WIND TUNNEL EXPERIMENTS ON THE DIVERGENCE OF SWEEP WINGS WITH COMPOSITE STRUCTURES Final Report

M. BLAIR Oct. 1982 78 p refs

(Contract AF PROJ 2401)

(AD-A127950; AFWAL-TR-82-3018) Avail: NTIS HC A05/MF A01 CSCL 01C

An elastic wing with variable sweep was designed and subcritically tested for aeroelastic divergence in the Virginia Tech six foot stability wind tunnel. This wing has an internal interchangeable graphite/epoxy plate that provides the wing stiffness. This plate had the shape of a high aspect ratio trapezoid with a line of symmetry coincident with the spanwise reference axis. A fiberglass aerodynamic shell with ten chordwise sections surrounds the plate. These shell sections were mounted so as to minimize their stiffness contribution to the plate and still maintain good aerodynamic performance. A series of six symmetric plates with various fiber orientations were constructed. Fiber layout on each plate is symmetric about the midplane parallel to the surface. By inverting the plate, it was possible to test 11 unique fiber orientations. Theoretically, identified test results predicted relationships between wing sweep, fiber orientation, and divergence speed. One configuration, tested to the divergence speed, showed

good correlation with the subcritically projected divergence speed
Author (GRA)

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations, and aircraft accidents.

A83-41042*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif
HELICOPTER IFR APPROACHES INTO MAJOR TERMINALS USING RNAV, MLS, AND CDTI

L. TOBIAS, H. Q. LEE, L. L. PEACH (NASA, Ames Research Center, Moffett Field, CA), F. M. WILLETT, JR., and P. J. OBRIEN (FAA Technical Center, Atlantic City, NJ) Journal of Aircraft (ISSN 0021-8669), vol. 20, Aug 1983, p. 666-673 refs

Previously cited in issue 06, p. 806, Accession no. A82-17868

A83-41079* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif

A SUMMARY OF NASA/FAA EXPERIMENTS CONCERNING HELICOPTER IFR AIRWORTHINESS CRITERIA

J. V. LEBACQZ, R. T. N. CHEN, R. M. GERDES, and J. M. WEBER (NASA, Ames Research Center, Moffett Field, CA) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 63-70. refs

A sequence of ground and flight simulation experiments was conducted to investigate helicopter instrument-flight-rules airworthiness criteria. The first six of these experiments and major results are summarized. Five of the experiments were conducted on large-amplitude motion base simulators. The NASA-Army V/STOLAND UH-1H variable-stability helicopter was used in the flight experiment. Artificial stability and control augmentation, longitudinal and lateral control, and in pitch and roll attitude augmentation were investigated. Previously announced in STAR as N82-23219 M.D.K.

A83-41467

SAFETY IN THE SKIES

P. KNAUTH Blue Ridge Summit, PA, TAB Books, Inc, 1982, 160 p.

The history and present status of air safety and control in the US is discussed. The growth of the airway system and the national weather-reporting network is traced, with consideration of the role of the FAA and the significance of the introduction of commercial jet aircraft in the late 1950's. The need for an operation of VOR systems, midair-collision-prevention devices, ILS, and advanced weather-information networks is illustrated with numerous examples. T. K.

A83-41691#

NEW CONCEPT FOR LOW COST VTOL CARGO DELIVERY CAPABILITY

F. M. WILSON, JR. (Lockheed-Georgia Co., Marietta, GA) and A. G. BENNETT (Mississippi State University, Starkville, MS) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 324-335. (AIAA PAPER 83-2207)

A concept has been developed for vertical delivery and retrieval of heavy payloads using conventional aircraft, and without landing or approaching the ground during the delivery/retrieval process. The principles involved have been developed analytically and demonstrated in flight at light aircraft scale. Analyses indicate that C-130 aircraft using this concept could vertically deliver and/or retrieve payloads up to about 20,000 pounds. Author

A83-42099* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EXPERIMENTAL COMPARISON OF ICING CLOUD INSTRUMENTS

W. OLSEN (NASA, Lewis Research Center, Cleveland, OH), D. TAKEUCHI (Meteorology Research, Inc., Altadena, CA), and K. ADAMS (USAF, Flight Test Center, Edwards, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Conference, 21st, Reno, NV, Jan 10-13, 1983. 26 p refs (AIAA PAPER 83-0026)

Previously announced in STAR as N83-24487

A83-42557#

FOD HAZARD FROM TIRE-LOFTED DEBRIS

S J BLESS, L A CROSS, A J. PIEKUTOWSKI (Dayton, University, Dayton, OH), and H F SWIFT (Physics Applications, Inc., Dayton, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings New York, American Institute of Aeronautics and Astronautics, 1983, p 12-1-1 to 12-1-5. (Contract F08635-82-K-0102)

Trajectories of tire-lofted particles were determined with a stereoscopic camera system. Tire speeds ranged up to 40 mph for single and dual wheel carriages. Concrete and packed dirt surfaces, both wet and dry, were covered with loose stones. Probability of lofting was typically 15 percent, until the stone density exceeded one stone per footprint area; then the lofting probability was much less. Launch directions were mainly within 20 degrees of the normal to the wheel. Launch velocities were mainly less than 2.5 m/s. The probability of launching debris to above 4 m/s was about 0.03. Angularity and size both increase lofting probability. Water did not greatly affect stone lofting, except for very small stones (1/4-inch). Extrapolations of these results to airfield scenarios predict that the danger of engine ingestion of nose-wheel generated debris is minimal. Author

A83-42558#

POWDER PACK PROTECTION FOR AIRCRAFT DRY BAYS

T J. SEYMOUR and P. S. ELLENWOOD (USAF, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings New York, American Institute of Aeronautics and Astronautics, 1983, p. 12-8-1 to 12-8-3 refs

This paper discusses the ballistic evaluation of powder packs as a fire protection scheme for aircraft dry bays adjacent to fuel cells. Powder packs were tested in the leading edge dry bay of a replica aircraft wing against both armor-piercing incendiary (API) and high-explosive incendiary (HEI) projectiles. Several variables, such as airspeed, hydraulic lines in the leading edge, and different extinguishant powders were evaluated to determine their impact on the fire extinguishing capability of the powder pack concept. Testing to date has shown that powder packs offer reliable fire protection for aircraft dry bays at a weight savings of more than 80 percent over solid-packed rigid foam. Author

A83-43407

THE SURVIVABLE AIRCRAFT FIRE

J M RAMSDEN Flight International (ISSN 0015-3710), vol 124, Aug 13, 1983, p. 432-434.

An analysis of in-flight airliner fire records indicates that cabin and fuselage fires, although only 17 percent of the total, account for more than half of all fatalities. Most airworthiness requirements of airliner cabin nonflammability have only called for the burning of small test strips at relatively low ignition temperatures. The actual in-flight fire problem is posed, however, by the flammability and smoke toxicity of polyurethane foam cushions upon ignition by higher temperature flames, and in bulk quantities. Polyurethane foam fires are distinguished from those of other combustibles in their production of hydrogen cyanide, carbon monoxide, and other toxic gases. O.C.

A83-43742* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif

OPTIMIZATION OF FIRE BLOCKING LAYERS FOR AIRCRAFT SEATING

J A PARKER and D. A KOURTIDES (NASA, Ames Research Center, Moffett Field, CA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 25 p (SAWE PAPER 1468)

Ablative materials are used to provide thermal protection for heat sensitive substrates against large jet fuel fires. The present investigation is concerned with the possibility to increase the available egress time for passengers, from a transport aircraft, in which the flexible polyurethane seating is exposed to the action of a large pool fire. Suitable approaches for providing sufficient ablative protection for polyurethane cushioning are considered. The efficiency of any fire blocking layer is defined as the ratio of the incident radiant heating rate, to the rate of production of combustible gas produced per unit area per second, generated by the pyrolysis of the substrate polyurethane foam. It is found that adequate fire blocking protection can be achieved through replacement of cotton batting slip covers with a wide variety of fire blocking layers. Metallized high temperature resistant char forming ablatives appear to provide optimum protection. G R

A83-43744

PHILOSOPHY OF AUTOMATED BALANCE CALCULATIONS

J. R. MCCARTY (United Air Lines, Inc., Chicago, IL) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 15 p (SAWE PAPER 1470)

The present study has the aim to outline the philosophy, or methodology, developed and employed by a U.S. airline for evaluating and controlling the balance aspects of a trip departure, taking into account the utilization of a real time computer program. The employed philosophy involves the use of the computer for performing a complete calculation or analysis in connection with each change in loading. This approach makes it possible to exploit loading flexibility considerations as much as possible, taking into account the exact passenger count, the exact cargo load, and the exact fuel load. The combinations are measured against the CG limits and related balance variations for the three operating modes of takeoff, enroute, and landing to evaluate the critical or controlling case for the flight. G R

N83-30398 Prins Maurits Lab TNO, Rijswijk (Netherlands)

BAIL OUT SIMULATION OF AN F-16 EJECTION SEAT BY MEANS OF A BLAST SIMULATOR [BAIL-OUT SIMULATIE VAN EEN F-16 SCHIETSTOEL MBV EEN BLASTSIMULATOR]

W HAVERDINGS Mar 1982. 17 p refs. In DUTCH, ENGLISH summary (Contract A79/KLU/155)

(PML-1982-7; TDCK-76716) Avail Issuing Activity

The functioning of the mode switch in the ejection seat of an F-16 jet fighter during bailout was studied in a 2 m diameter blast simulator. Pitot pressures at the mode switch position encountered in reality were used. The influence on the mode switch of different types of helmet placed upon the head of a dummy in the ejection seat was investigated. Although the blast simulator is capable of simulating a bailout under certain conditions, the static pressure is too high compared to the dynamic pressure. Since the flow at the pitot input can be assumed stationary, the experimental investigation can better be performed in a wind tunnel.

Author (ESA)

N83-30399# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate

EJECTION SEAT-MOUNTED CREWMEMBER RESTRAINT INTEGRATED WITH SURVIVAL VEST AND FLOTATION

T J ZENOBI 15 Nov. 1982. 33 p (AD-A126859, NADC-82216-60) Avail: NTIS HC A03/MF A01 CSCL 06G

The Navy is developing a flight restraint integrated with a survival vest and life preserver which is mounted on the aircraft ejection

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seat. This integration uses three standard items which are minimally modified. This development is intended to improve comfort for the crewmember and to simplify logistic support without sacrificing performance. GRA

N83-31190 McDonnell Aircraft Co., St. Louis, Mo.
A REALISTIC APPROACH TO AIRCRAFT LIGHTNING PROTECTION

G. L. WEINSTOCK *In* FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 3 p Jun. 1983 refs
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

A probabilistic approach to the design of aircraft lightning protection which may be a useful method of avoiding conventional worst case design penalties is presented. The application of the specifications lightning protection to aircraft is made without consideration of mission, probability of strike occurrence, or penalties associated with protective designs. Data from recent in flight test programs, all show that the requirements may be too stringent and that a revision to the method of applying lightning specifications to aircraft may be justified. In conventional and V/STOL high-technology fighter aircraft, weight has a direct effect upon performance, combat effectiveness, losses, and life cycle cost. Unnecessarily stringent lightning protection requirements can add weight out of protection to the lightning risk. A systematic method of tailoring requirements to risk or damage probability is desirable to provide a more balanced protective design E.A.K.

N83-31192 Boeing Military Airplane Development, Seattle, Wash.

ATMOSPHERIC ELECTRICITY THREAT DEFINITION FOR AIRCRAFT LIGHTNING PROTECTION

B. G. MELANDER *In* FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec 37 p Jun 1983 refs
(Contract F33615-82-C-3406)
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

A consistent atmospheric electricity (AE) threat environment for use in the protection of aircraft electronic/electrical systems is described. The definition evolved from measurements of direct strikes to aircraft and ground installations. The AE threat definition includes threats of two basic types. (1) all lightning associated threats; and (2) static electrification threats. Cloud to ground lightning was studied and is used as the basis for the present lightning threat definition. The defined threat is compared to available cloud to ground lightning strike data. Intracloud discharges, are usually less severe. Characterization of static electrification including streamers and corona are included in the total atmospheric electricity threat. Static electrification is caused by both tribo electric and exogenous charging which creates both corona and streamers. The threat includes the best currently available data for both lightning and static charging phenomena. The threat definition will ultimately be used to define future protection and qualification requirements. E.A.K.

N83-31193 Bundesamt fuer Wehrtechnik und Beschaffung, Koblenz (West Germany)

LIGHTNING STRIKES TO AIRCRAFT OF THE GERMAN FEDERAL ARMED FORCES

W. ZIEGLER *In* FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec 8 p Jun. 1983 refs
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Lightning strikes to aircraft of the Federal Armed Forces from 1973 until 1982 were surveyed. About 80% of the lightning strikes involved the following 4 types of aircraft: F-104 G Star-fighter, F-4 Phantom, C-160 Transall, BR-1150 Breguet Atlantic. The annual rates of lightning strikes as well as the average rates over these 10 years are shown. The main locations at which lightning attached to the aircraft and damage sustained are described. Two lightning strikes are discussed. Problems that are expected to result from the greater use of CFC for the airframe, the increasing employment

of computers, and the electrical transmission of essential control signals are discussed. E.A.K.

N83-31195* National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

NASA F-106B LIGHTNING GROUND TESTS

B. D. HEADY (McDonnell Aircraft Co.) and K. S. ZEISEL (McDonnell Aircraft Co.) *In* FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 7 p Jun 1983 refs
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Lightning simulation ground tests conducted on the NASA F-106B research aircraft to elicit natural strikes are summarized. The purpose of the test program was to measure the response of the aircraft's electromagnetic sensors and interior wire circuits to a controlled ground test environment that simulates the electromagnetic effects of a lightning strike. Both direct attachment and radiated field tests were conducted. In most cases, the aircraft's engine was running and test data were gathered simultaneously from NASA and MCAIR sensors on both the aircraft's own instrumentation system and the remote MCAIR computer-controlled data acquisition system. During the direct attachment tests, the input inductance, output condition (hard-wired or spark gap), and the output location were varied to provide a wide variety of test conditions. Author

N83-31196 Royal Aircraft Establishment, Farnborough (England).

INDUCED TRANSIENTS IN A SIMULATED LIGHTNING TEST OF THE FLY-BY-WIRE JAGUAR AIRCRAFT

R. H. EVANS and J. BISHOP *In* FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec. 14 p Jun. 1983 refs
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Simulated lightning tests were performed on the Jaguar aircraft modified for demonstrating fly-by-wire technology. A pulse generator injected currents of 100 kA maximum into the fuselage; measurements were made of induced voltage and current transients in cables, currents and magnetic fields in equipment bays, current density on the fuselage and wings, and rate of change of electrical field at two locations. Full-threat estimates were obtained by extrapolation. Some remarks are included on the consistency and accuracy of the results and their realism in relation to actual in-flight strikes. Author

N83-31207 Syracuse Research Corp., N. Y.
THE EFFECTS OF NEW TECHNOLOGY TRENDS ON AIRCRAFT LIGHTNING VULNERABILITY AND THE CAPABILITY TO IDENTIFY TECHNOLOGY DEFICIENCIES

D. T. AUCLAND, R. F. WALLENBERG, and J. A. BIRKEN (Naval Air Systems Command) *In* FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 9 p Jun 1983 refs
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Operational aircraft representing the 1960 and 1970 technology time frames were tested in the Full-Level Lightning Aircraft System Hardening (FLLASH) program at Albuquerque, New Mexico, during the spring and summer of 1982. The direct-strike lightning threat was simulated and peak injection currents of 180 kA were achieved. A method was developed during this program which enables the aircraft designer to perform trade-off studies at very early design stages involving avionics packages, airframe configurations, and various threat scenarios. Author

N83-31208 Syracuse Research Corp., N. Y.
UNPROTECTED RADOME LIGHTNING TESTS AND IMPLICATIONS TO KEVLAR AIRFRAME DESIGNS

D. T. AUCLAND and J. A. BIRKEN (Naval Air System Command) /n FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 6 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J \$25.00

A fiberglass radome, mounted on an operational aircraft, was subjected to a direct lightning strike attachment experiment. It was found that lightning diverter strips could be effectively used to prevent damage from occurring to the radome. Omission of any protective scheme, however, resulted in burnthrough of the radome surface and arcing to the edge of the phased array radar antenna. These test results are discussed in context with the application of nonconducting composite materials, such as Kevlar, to airframe component design. Author

N83-31210 Naval Research Lab., Washington, D. C.
ELECTROSTATIC THEORY APPLIED TO HELICOPTER DISCHARGING

R. V. ANDERSON /n FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 8 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J \$25.00

An electrostatic analysis is made of a hovering vehicle out of electrical contact with the ground. Charging of the vehicle is seen to be accomplished by a variety of mechanisms. Engine exhausts are strongly ionized; and, since they are physically localized at the stack(s), can be modulated to produce vehicle charging. Strong charging can result from the frictional contact of dust, ice, or water particles with the vehicle skin, and the processes of conduction and diffusion will operate to remove net charge from any isolated object. The electrostatics of an isolated body above a ground plane are reviewed and developed. Expressions are presented for charge, potential difference, and current. Typical physical situations are applied to allow presentation of meaningful examples. The theory and practice of net charge control as applied to an isolated body are briefly reviewed, and it is shown that discharge impulses upon initial contact cannot be eliminated by any system contained solely within an isolated vehicle. Author

N83-31211 Westland Helicopters Ltd., Yeovil (England)
ADVANCED TESTING OF LIGHTNING PROTECTION SCHEMES FOR COMPOSITE MAIN ROTOR BLADES (HELICOPTER)

M. J. HESELTINE /n FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 9 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J \$25.00

The choice of composites, with their structural and aerodynamic advantages, for helicopter main rotor blades is briefly discussed along with some of the difficulties associated with their design, manufacturing and testing. The necessity for lightning and erosion protection for the blade's leading edge and the desire for early evaluation of projected design schemes are addressed. Attention is drawn to the lengthy lead time between the designing of a blade and the arrival of suitable, expensive tooling required to examine an actual blade specimen. A technique was developed which satisfies both the designer and the accountant. A blade is imagined to be cut, spanwise, from root to tip through the trailing edge and spar rearwall. The blade is then opened out like a book. If care is taken with the manufacture of the flat test specimen various lightning protection schemes can be evaluated well in advance of prototype blade specimens. A selection of protection schemes and the effect of varying the engineering tolerances of erosion shield assembly and the extent of damage so caused. The information gained through this work enabled blade design to be finalized well before actual blade specimens became available for test. Testing showed close correlation to the results of their flat counterparts. M.G.

N83-31214 Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

LIGHTNING INTERACTION WITH USAF AIRCRAFT

J. C. CORBIN /n FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 6 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J \$25.00

Data from 877 USAF aircraft lightning-related mishap reports involving 56 aircraft types over a 13-year period (1970 to 1982) are categorized and analyzed. Aircraft are grouped into six general classes: attack, bomber, cargo, fighter, trainer, and helicopter. Data are tabulated under two major headings: operational conditions at the time of the lightning strike, and the effects of the strike. Operational conditions include aircraft attitude, aircraft altitude, outside air temperature, aircraft location (with respect to clouds), precipitation/turbulence, and electrical activity prior to the strike. Effects of the strike include attachment point, interference/outage, effect on mission, effect on personnel, structural damage, electrical/electronic damage, and repair/replacement costs. Interference/outage in the form of an abnormal condition observed following a strike was experienced in 20 percent of the reported lightning incidents. Aircraft was affected in 37 percent of the reported incidents, but in most cases where lightning caused a precautionary abort subsequent ground inspection of the aircraft revealed only minor structural damage. Structural damage was experienced in 78 percent of the reported incidents. Electrical/electronic damage was sustained in 8 percent of the reported incidents. M.G.

N83-31220 Sandia Labs., Albuquerque, N. Mex
PERFORMANCE OF THE SANDIA LIGHTNING SIMULATOR DURING F-14A AND F/A-18 AIRCRAFT LIGHTNING TESTS

R. I. EWING /n FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 4 p Jun. 1983
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J \$25.00

Two Navy aircraft (F-14A and F/A-18) were subjected to high level lightning tests using the Sandia Lightning Simulator. The peak pulse currents applied were varied from 9 to 170 kiloamperes. The nominal rise time to peak was 2 microseconds. Double pulse and continuing currents were also applied. Several high current, high voltage pulses were also obtained. Ninety-six test pulses were applied to the F-14A and sixty-four pulses were applied to the F/A-18. Approximately eighty percent of these pulses met the test specifications and essentially all pulses produced useful data. Author

N83-31221 Haefely (Emile) and Co. Ltd., Basel (Switzerland)
AN IMPULSE GENERATOR TO SIMULATE LIGHTNING EFFECTS ON AIRCRAFT

E. GÖCKENBACH, M. MODRUSAN, and H. SUTTER /n FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 11 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J \$25.00

Lightning flashes mainly differ in current amplitude, in the transferred charge, and the impulse shapes of the lightning current. A mobile impulse generator was developed for the simulation of the lightning flash characteristics. The main parameter of this newly developed lightning current simulator is the possibility of simulations the different waveforms of the indirect current effects with one test equipment. It can produce unipolar currents up to 50 kA with a rate of rise of 35 kA/us for at least 1.0 us. With the same equipment oscillating current waves can be simulated with peak values up to 120 kA or at frequencies of roughly 40 kHz or few kA at frequencies up to 130 kHz. Furthermore, an optimal combination of test sets is presented to simulate the direct current effects. M.G.

N83-31222 Lightning and Transients Research Inst., St. Paul, Minn.

MEASUREMENTS AND THEORETICAL ANALYSIS OF A FULL SCALE NEMP

J. D. ROBB and R. A. PERALA (Electro Magnetic Associates) /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 12 p. Jun. 1983 refs. Sponsored in part by AFWAL

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

In an earlier investigation, it was suggested that peaking capacitors are used in nuclear electromagnetic pulse simulators to supply the fast current rise times indicated by research in the field of lightning spherics and lightning strikes to aircraft. A more quantitative experimental and analytical study was undertaken to examine the feasibility and the significant parameters for such a system. The results of the studies indicate that average lightning currents of 20,000 to 40,000 amperes with moderately fast rise times of 100 nanoseconds can be achieved fairly economically, but that rise times of the order of 30 to 50 nanoseconds would increase the cost and design difficulties significantly. What remains to be determined is the statistical distribution of currents and risetimes in strikes to aircraft. A number of flight research programs are underway which are accumulating data for establishment of new rise time test standards. M.G.

N83-31224 Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

VULNERABILITY ASSESSMENT OF ELECTRICAL/ELECTRONIC SUBSYSTEMS AND EQUIPMENT TO ATMOSPHERIC ELECTRICITY

J. R. LIPPERT /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 8 p. Jun. 1983

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

During phase 1 of the Atmospheric Electricity Hazards Protection (AEHP) Program, the sensitivity of several generic classes of electrical/electronic subsystems and equipment will be assessed to electrical/electromagnetic threats associated with atmospheric electricity; e.g., lightning and precipitation static generated currents, fields, and potentials. This will be accomplished through the utilization of appropriate atmospheric electricity simulation and various test vehicles for flight/mission critical subsystem/equipment evaluation for operation in atmospheric electricity generated electrical/electromagnetic environments. Simulation techniques contemplated for use on this task as well as specification of the environmental parameters to be simulated are discussed. In addition, the testbeds planned to be used, including advanced composite skin modifications, are identified.

Author

N83-31230 Boeing Commercial Airplane Co., Seattle, Wash.

P-STATIC FLIGHT EVALUATION OF A LARGE JET AIRCRAFT

C. H. KING /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 43 p. Jun. 1983 refs.

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

The use of static dischargers to reduce P-static interference in radios is universal in large modern aircraft. These devices, although they quietly discharge the aircraft, represent drag and weight penalties and can delay dispatch of a flight if discharges at key locations are missing. Flight tests were conducted on a modern jet transport to determine the location and number of dischargers required for dispatch. Traditionally the minimum complement is based upon engine charging; i.e., only those dischargers required to quietly discharge the current produced by operating the engines in clear air would be required for dispatch. The aircraft was instrumented to measure current, discharge current, ADF radio noise and field potential. The data from this instrumentation was recorded on a system which sampled data at a rate of 5 times per second. Data plots obtained during various charging conditions are presented. Author

N83-31236* National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

CONDITIONS CONDUCTIVE TO LIGHTNING STRIKING AN AIRCRAFT IN A THUNDERSTORM

V. MAZUR (Oklahoma Univ.), B. D. FISHER, and J. C. GERLACH /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 7 p. Jun. 1983 refs.

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

The UHF band radar at NASA/Wallops Island Research Facility was used for guiding the NASA F106 research aircraft through the upper regions of storms with lightning activity in them so that the aircraft would be struck by lightning. The radar was used also as a tool to study nature and the characteristics of direct lightning strikes on the aircraft, and to determine the environmental conditions favorable to such strikes. The analysis of lightning echoes at the moments of the strikes strongly indicates that the aircraft itself triggers the lightning, rather than intercepting a naturally produced flash. Correlations between the probability of a direct strike during a storm penetration and the intensity of rain and turbulence, temperature, and lightning flash rate in the storms penetrated were investigated. R.J.F.

N83-31240 SRI International Corp., Menlo Park, Calif.

ALLOCATION OF PROTECTION

E. F. VANCE, J. E. NANEVICZ, W. GRAF, and J. M. HAMM /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 5 p. Jun. 1983

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

A procedure for determining how much protection is needed between the external lightning environment and the circuits inside equipment is developed on the basis of nested shields or electromagnetic barriers. Part of this protection is usually placed at the system level (at the aircraft skin or at a facility shield) and part may be placed at the equipment level. Four distinct allocations of protection are defined and their implications on electromagnetic compatibility and protection against lightning and other external sources are discussed. In two of these, all of the protection is allocated to one level and none is allocated to the other. When all protection is allocated to the system level, all internal cabling and equipment is protected, and no configuration control or lightning requirement on equipment is needed inside the system-level barrier to maintain the protection. When all protection is allocated to the equipment or box level, however, unprotected cabling and other system structure may remain outside the protected space (i.e., outside the boxes). R.J.F.

N83-31242 Boeing Vertol Co., Philadelphia, Pa.

PROTECTING THE WORLD'S LARGEST COMMERCIAL HELICOPTER FROM ATMOSPHERIC HAZARDS

G. A. HEIDERSCHIEDT /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 17 p. Jun. 1983 refs.

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

An in-depth look at the lightning protection features of the world's largest commercial helicopter, the Boeing 234, is given. This aircraft regularly carries 44 passengers over 580 nautical miles across water, in IFR and VFR flight conditions, at altitudes consistently placing it in foul weather conditions. The aircraft is examined from the viewpoint of systems and system protection, composite external fuel pods, composite crew nose section, radome protection and, where appropriate, specific subsystem protection. Inservice lightning strike experience is presented as well as future plans for the aircraft. R.J.F.

N83-31586*# Dayton Univ, Ohio. Research Inst.
A COMPUTER SIMULATION OF AIRCRAFT EVACUATION WITH FIRE

V E. MIDDLETON Apr 1983 67 p
 (Contract NAS2-11184)
 (NASA-CR-166511, NAS 1.26 166511) Avail: NTIS HC A04/MF A01 CSCL 01C

A computer simulation was developed to assess passenger survival during the post-crash evacuation of a transport category aircraft when fire is a major threat. The computer code, FIREVAC, computes individual passenger exit paths and times to exit, taking into account delays and congestion caused by the interaction among the passengers and changing cabin conditions. Simple models for the physiological effects of the toxic cabin atmosphere are included with provision for including more sophisticated models as they become available. Both wide-body and standard-body aircraft may be simulated. Passenger characteristics are assigned stochastically from experimentally derived distributions. Results of simulations of evacuation trials and hypothetical evacuations under fire conditions are presented. Author

N83-31587# Naval Research Lab, Washington, D C Combustion and Fuels Branch.

CB AGENT THREAT TO ATMOSPHERE INSIDE NAVY AIRCRAFT Interim Report

R A KAMONTAGNE and H W. CARHART 11 May 1983 11 p refs
 (AD-A127882; NRL-MR-5085) Avail: NTIS HC A02/MF A01 CSCL 15B

The CB agent threat to personnel in closed crew compartments is a serious problem. Research on the decomposition of agents which pass into jet engine compressors and/or heat exchangers has shown that total agent decomposition is not attained. Agent decomposition in jet engine heat exchangers and compressors is a function of agent concentration, temperature, exposure time, surface catalysis and other constituents present in the air.

Author (GRA)

N83-31588# Coast Guard Research and Development Center, Groton, Conn

AN EVALUATION OF SARP (SEARCH AND RESCUE PLANNING SYSTEM) DRIFT PREDICTIONS USING SATELLITE-TRACKED DRIFT-BUOYS Interim Report, Jan. 1979 - Mar. 1981

D. L. MURPHY, L. NASH, D. F. CUNDY, and S. R. OSMER Dec 1982 95 p refs
 (AD-A127987, USCG-D-05-83, CGR/DC-24/82) Avail: NTIS HC A05/MF A01 CSCL 06G

During the period of 1979 through 1981 the USCG Research and Development Center conducted several experiments in which the drift predictions of the computerized Search and Rescue Planning System (SARP) were compared with the movement of satellite-tracked drift-buoys released in the Gulf Stream east of Florida. Buoy positions at specific times were used as the last known position and incident date-time-group of a simulated search and rescue (SAR) incident; subsequent buoy positions were used to test the accuracy of 24, 48, 72, 96, and 120 hour drift predictions. Of the 680 drift predictions evaluated, in only 41 cases (6.0%) was the interpolated buoy position within the SARP-predicted search area. The accuracy of the drift predictions degraded with increasing prediction time. There was no discernible difference between the predicted (forecast) and analysis (observed) wind results; if the effect of wind is not included in the drift prediction the result is a larger relative drift error. The sea current files used in the SARP drift predictions contain some systematic errors which adversely affect system performances; and The drift error factor presently in use seriously underestimates the total drift error.

GRA

N83-31589# Simula, Inc., Tempe, Ariz
DESIGN AND TEST CRITERIA FOR INCREASED ENERGY-ABSORBING SEAT EFFECTIVENESS Final Report, Jun 1979 - Feb. 1983

J. W. COLTMAN Mar. 1983 229 p refs
 (Contract DAAK51-79-C-0026; DA PROJ. 1L1-62209-AH-76)
 (AD-A128015, USAAVRADCOM-TR-82-D-42; NADC-82268-60; TR-82411; FAA-AM-83-3) Avail: NTIS HC A11/MF A01 CSCL 01B

This report documents a research effort to increase the effectiveness of energy-absorbing seats, through improved design and qualification test criteria. Contained herein are descriptions of a parametric test program and analysis of seat and occupant response sensitivity to design and test variables. Author (GRA)

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft, air navigation systems (satellite and ground based), and air traffic control.

A83-40759

AIRBORNE RADAR AND THE THREE PRFS

F. C. WILLIAMS and M. E. RADANT (Hughes Aircraft Co., Radar Systems Group, Los Angeles, CA) Microwave Journal (ISSN 0026-2897), vol. 26, July 1983, p. 129, 130, 132-135 refs

The ambiguity function is presented as the basic tool for assessing radar performance for various transmitted waveforms. High, medium and low PRF waveforms are considered for airborne radar search systems that have antennas a few feet in diameter. It is noted that low PRF radars are severely limited by the Doppler spread of the mainlobe clutter signal. High PRF radar furnishes complete separation of targets from clutter for targets approaching nose-on to the search aircraft. Long-range detection is possible in this case, with the performance determined primarily by the usual power-aperture product. High PRF detection of receding targets is more severely limited owing to sidelobe clutter. Medium PRF pulse Doppler systems that are moderately ambiguous in range provide good overall discrimination of clutter, although the maximum range search performance will inevitably be limited by sidelobe clutter.

C.R.

A83-40880

RADIONAVIGATION IN THE YEAR 2001 [LA RADIONAVIGATION EN L'AN 2001]

D. C. SCULL (U.S. Department of Transportation, Washington, DC) (International Omega Association, Annual Meeting, Arlington, VA, Oct 12-14, 1982) Navigation (Paris) (ISSN 0028-1530), vol. 31, July 1983, p. 309-317. In French

The precision, economic driving forces, planning, administration, and users of radionavigation system at the turn of the century are discussed. Congressional legislation was passed in 1979 to combine DoD and DoT efforts to produce a radionavigation system for both air and maritime transport, accessible to military and civilian craft. Particular attention is being given to replacement of VOR/DME, Loran-C, and Omega systems with the Navstar/GPS. Precision criteria have been defined for oceanic and air transport en route, for terminal approach, for nonprecision approach, and for horizontal and vertical distances, showing that Navstar is not precise enough for landing approaches. It is not yet known whether or not inertial navigation systems can be developed that allow navigation without references to outside reference sources. Additionally, if the US initiates development of internationally acceptable systems, decisions and agreements must still be made as to the distribution of costs, availability, and the problems of sharing military technology with civil traffic.

M.S.K.

A83-41226#

THE ROLE OF THE AIR FORCE IN THE TRANSFER OF GENERAL-AVIATION-TRAFFIC CONTROL FROM ITAV TO AAHV/TAG [IL RUOLO DELL'AERONAUTICA MILITARE NEL PASSAGGIO DEL CONTROLLO DEL TRAFFICO AEREO GENERALE DALL'I.T.A.V. ALLA AAHV/TAG]

L. AREZZO (Ispettorato delle Telecomunicazioni ed Assistenza al Volo, Rome, Italy) Istituto Italiano di Navigazione, Atti, Jan.-Mar 1983, p. 5-21 In Italian.

A83-41228#

INSTRUMENT-APPROACH TECHNIQUE FOR POOR-VISIBILITY LANDINGS [TECNICA DEGLI AVVICINAMENTI STRUMENTALI PER L'ATTERRAGGIO CON SCARSA VISIBILITA']

E. VINCENTI (Direzione Generale dell'Aviazione Civile, Servizio Navigazione Aerea, Rome, Italy) Istituto Italiano di Navigazione, Atti, Jan.-Mar. 1983, p. 47-77. In Italian.

The regulations, techniques, and technology of instrument approach and landing are surveyed. The basic communications requirements upon arrival at the edge of an ATC zone and the visibility minima for VFR and IFR approaches are reviewed. The ICAO definitions of transition altitude, transition level, and transition layer are presented, and the operative parameters under the ICAO approach system are considered. Radio aids, obstacle clearances, and both tangible and intangible basic criteria for IFR approaches are listed. Specific maneuvers required by the procedural rules for ILS, PAR, NDB, VOR, and MLS are described and illustrated. MLSs are considered in greater detail, including the requirements imposed by the ICAO, configurations, sources and limits of error, and advantages as compared to ILS. T K.

A83-41310#

AN OVERVIEW OF A NEW INTEGRATED SYSTEM FOR COMMUNICATION, NAVIGATION, AND IDENTIFICATION - THE JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM [UNA PANORAMICA SU UN NUOVO SISTEMA INTEGRATO DI COMUNICAZIONE, NAVIGAZIONE E IDENTIFICAZIONE - IL JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM]

F. CHIARINI, G. MAGLI, and F. VATALARO (Industrie FACE Standard, Milan, Italy) Istituto Italiano di Navigazione, Atti, Dec. 1982, p. 7-25. In Italian. refs

JTIDS, the high-capacity decentralized communications system being developed for use by the US armed services is characterized. Flexibility and real-time responsiveness, adequate capacity, resistance to jamming, interception, and exploitation, and high-precision distance measurement for relative and absolute navigation are among the primary goals of the system, which is being developed in two phases. In phase I, TDMA technology is employed to link current voice and data communications terminals; in phase II, DTDMA will improve capacity and security while simplifying system management. The technological aspects of DTDMA are discussed in detail, including base intervals, channel modulation concept, types of channels, synchronization with TDMA, and methods used for navigation in relative coordinates. The capacity, security, flexibility, compatibility with multiple independent networks, noise characteristics, and costs of the TDMA and DTDMA systems are compared. T.K.

A83-41528

RADIONAVIGATION - RADIOLOCATION [RADIONAVIGATION: RADIOLOCALISATION]

P. FOMBONNE Paris, Masson, 1983, 299 p. In French. refs

The analytical bases and operating equipment for radionavigation and radiolocation systems are explored. Navigation is defined as the means to guide a moving body to a given destination. It can be accomplished by estimating position on the basis of departure time and velocity, by location through correlation or by pure location, and by following beacons. Location can be determined by terrestrial coordinates, spatial references, or local references, which are modified by the time scales used in different systems. Attention is given to features of the propagation of radio signals through the atmosphere and space, as well as to quantitative evaluation of the precision of existing systems.

Operational systems are reviewed, including the radio ranging systems such as VOR and TACAN, the distance measuring equipment (DME), the hyperbolic location systems Decca, Loran C, and the Omega, and the Transit and Navstar/GPS satellite systems. Finally, automatic navigation systems employing Doppler capabilities are examined. M S K.

A83-41531

ADVANCED HELICOPTER AVIONICS

R. B. LEWIS, II (U.S. Army, Aviation Research and Development Command, St. Louis, MO) Vertiflite (ISSN 0042-4455), vol. 29, July-Aug. 1983, p. 22-25.

A discussion is presented of the programs undertaken by the U.S. military to develop integrated avionics systems for military helicopters. The current situation of avionics in military helicopters is discussed, focusing on the limitations imposed on the pilots by outdated and inefficient equipment. The development program conducted by the U.S. Army Aviation Research and Development Command for defining the avionics systems that will be needed in the future and what components and subsystems are necessary to make them affordable, efficient, and survivable is examined in relation to digital systems integration. Two key facilities designed to insure the U.S. Army's ability to demand and successfully integrate these planned modern avionics configurations (Tactical Avionics Systems Simulator and the Systems Test Bed for Avionics Research) are examined. Also discussed is the Army Helicopter Improvement Program to develop an integrated cockpit. In addition, the projected family of light helicopters is examined, focusing on the improvements in electronic circuitry which will reduce crew workload through higher levels of automation. N B.

A83-41662#

NEW TARGET MODELS FOR HOMING MISSILE GUIDANCE

D. G. HULL, J. L. SPEYER (Texas University, Austin, TX), and P. C. KITE (Vought Corp., Dallas, TX) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 22-29 refs (Contract F08635-81-R-0211) (AIAA PAPER 83-2166)

Two extended Kalman filters (EKF) are derived utilizing different versions of a new, circular, target acceleration model. The numerical experiments are conducted on a two-dimensional simulation of a homing missile with angle-only measurement intercepting a maneuvering target, and the two filters are compared with each other based on tracking error performance. Results of a Monte Carlo analysis show that modeling the target acceleration magnitude as a random process produces a superior filter compared with modeling it as a bias. Author

A83-41663#

DIGITAL HOMING GUIDANCE - STABILITY VS. PERFORMANCE TRADE-OFFS

F. W. NESLINE, JR. and P. ZARCHAN (Raytheon Co., Missile Systems Div., Bedford, MA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 30-38 refs (AIAA PAPER 83-2167)

Digital signal processing capability can be added to a missile homing guidance system to provide a broad system decision capability against a complex threat. This processing may be on the ground or in the missile. Wherever it is, it introduces additional dynamics into the guidance loop which can degrade system performance. In fact, the influence of digitization is so important that it must be included at the outset in order to ensure that a guidance system design will work. One of the most significant effects is the introduction of a sample and hold in the guidance attitude loop. This paper discusses the influence of digital procession on system relative stability and performance. A variety of techniques for improving system performance are introduced and trade-off curves are presented that show how to specify major subsystem parameters, such as seeker stabilization loop gain or

autopilot time constant. The results show the trade-offs between a robust set of guidance subsystem specifications and acceptable performance when digital guidance is used. Author

A83-41665#

DESIGN OF AN INTEGRATED STRAPDOWN GUIDANCE AND CONTROL SYSTEM FOR A TACTICAL MISSILE

D. E. WILLIAMS, J. RICHMAN, and B. FRIEDLAND (Singer Co., Kearfott Div., Little Falls, NJ) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 57-66. (AIAA PAPER 83-2169)

An integrated guidance and control system for tactical missiles is designed using optimum control and estimation theory. Sensors used in this design consist of strapdown accelerometers and rate gyros and a strapdown homing seeker. Error sensitivities and performance characteristics are given for an intercept scenario involving a thrusting bank-to-turn missile against a maneuvering target. For a co-altitude parallel offset (sidestep) maneuver, miss distances with perfect sensors were less than 4 feet. The principal sensor error sources were found to be seeker quantization and gyro scale factor errors. In addition it was found that seeker cutoff prior to impact, i.e., 'blinding' and the seeker sampling interval has an important effect on end-game performance and terminal miss distance. Author

A83-41666#

LINE OF SIGHT RECONSTRUCTION FOR FASTER HOMING GUIDANCE

F. W. NESLINE and P. ZARCHAN (Raytheon Co., Missile Systems Div., Bedford, MA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 67-74. refs (AIAA PAPER 83-2170)

Implementations of proportional navigation guidance for radar homing missiles are examined in order to realize faster guidance time constants in the presence of imperfect seeker stabilization. Guidance system stability and miss distance analyses are presented, and the sensitivity to turning rate time constant and radome slope is considered. It is shown that line-of-sight (LOS) reconstruction relaxes stabilization loop requirements over conventional implementations. For a given stabilization loop gain, faster guidance time constants and smaller miss distances can be achieved with LOS reconstruction. C.D.

A83-41681#

THE USE OF MULTIPLE INERTIAL SYSTEMS TO CORRECT FOR THE EFFECTS OF GRAVITATIONAL ANOMALIES

J. RICHMAN (Singer Co., Kearfott Div., Little Falls, NJ) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 218-224. refs (AIAA PAPER 83-2196)

The use of multiple inertial platforms physically displaced from each other to reduce navigational errors caused by gravitational anomalies is considered. It is shown that the use of a Kalman filter can provide significant improvement in navigation accuracy. A surprising property of the Kalman filter in this application is its ability to reduce the navigational errors without significantly improving the estimates of those states causing the errors. Navigational performance is shown to remain unaffected by constant inertial component errors but tends to degrade as a result of their random errors. The degree of degradation is found to depend primarily upon the spectral density of the random error in the vicinity of the Schuler frequency. Author

A83-41684#

THE MANEUVER ACCELERATION PARAMETER - A FIGURE OF MERIT FOR EVALUATING MISSILE MISS DISTANCE PERFORMANCE

R. L. FORTENBAUGH (Vought Corp., Dallas, TX) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 245-253. (AIAA PAPER 83-2199)

A rationale is developed for combining missile maneuvering capabilities and mission segment acceleration requirements in the Maneuver Acceleration Parameter (MAP) which, by definition, is independent of guidance implementation. Easily and efficiently calculated, MAP is shown to correlate with miss distance with MAP no more than 0.5-0.6 providing a preliminary design goal for missile configurations. MAP sensitivities to the fundamental propulsion, aerodynamics and mass properties parameters of missile maneuvering are interpreted to establish equi-performance equivalencies among these parameters. These properties are demonstrated for two example missiles. Extensions to MAP are suggested for incorporating target maneuvers, short time mission segments, and system noise. Author

A83-41717*#

National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

MIXING 4D EQUIPPED AND UNEQUIPPED AIRCRAFT IN THE TERMINAL AREA

L. TOBIAS, H. ERZBERGER, H. Q. LEE (NASA, Ames Research Center, Moffett Field, CA), and P. J. OBRIEN (FAA, Technical Center, Atlantic City, NJ) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 570-579. refs (AIAA PAPER 83-2240)

The problem of mixing four-dimensional (4D) equipped aircraft (aircraft equipped with on-board guidance systems that can predict and control the touchdown-time of an aircraft to an accuracy of a few seconds throughout the descent) with unequipped aircraft in the terminal area has been investigated via a real-time air traffic control simulation study. The objective of this study was to develop scheduling algorithms and operational procedures for various traffic mixes that ranged from 25 percent to 75 percent 4D equipped aircraft. Results indicate substantial reduction in controller workload and an increase in orderliness when more than 25 percent of the aircraft are 4D equipped. Moreover, this is accomplished without increasing the workload or adding delays for the unequipped aircraft. Author

A83-41718#

FLIGHT SOFTWARE FOR OPTIMAL TRAJECTORIES IN TRANSPORT AIRCRAFT

C. N. GORDON (General Motors Corp., Goleta, CA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 580-583. refs (AIAA PAPER 83-2241)

A Fuel Savings Advisory System has been developed as part of the Fuel Savings Advisory/Cockpit Avionics System for the C-135 fleet of transport aircraft. It generates optimal flight paths which achieve minimum fuel usage over a given range with flight time open, or which provide reduced flight times at some additional cost in fuel. Flight paths are restricted to climb at full power, cruise at constant altitude with possible step climbs, and descent at idle thrust setting. The optimizing algorithm is derived from the Calculus of Variations and utilizes calibrated engine and airframe models to compute speed and power setting advisories for display to the pilot. Author

A83-41719#

4 D FUEL-OPTIMAL GUIDANCE IN THE PRESENCE OF WINDS

A CHAKRAVARTY (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 584-593 refs (AIAA PAPER 83-2242)

The present investigation makes use of 'matched asymptotic expansions' and the energy state approximation to develop a real-time algorithm for a fuel-optimal aircraft trajectory for fixed terminal time. The mathematical formulation is presented, taking into account the aircraft equations of motion, the performance index, Pontryagin's minimum principle, the cruise cost function, and the climb/descent cost function. The implementation of the considered approaches is illustrated with the aid of a number of examples, giving attention to cruise costs, a fuel-optimal cruise with descent, and optimal trajectories in the presence of winds. Aspects of suboptimal strategies are also discussed. It is concluded that fuel efficient delay absorption requires a reduction in cruise altitude together with speed reduction. A tailwind is found to increase the cost of absorbing delays

G R

A83-41762#

FUNCTIONAL DEVELOPMENT OF THE 757/767 DIGITAL CAT. IIIB AUTOLAND SYSTEM

D R SCHAEFFER (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 898-912 (AIAA PAPER 83-2192)

The paper discusses the functional development of the automatic landing system provided to all customers of the Boeing 757 and 767. This system incorporated all new digital hardware, as did virtually all of the airplanes electronic systems. Authority to depart from previous automatic landing system designs in order to satisfy tightened certification requirements and even more stringent program performance objectives was used to integrate software and develop new control law features and architecture. This development was guided by philosophies designed to overcome problems of previous systems. Special attention was given to develop analytic tools, procedures, and organization structures that enhance engineering productivity, required to satisfy very tight program constraints, manpower and experience limitations, and late definition of aerodynamics, propulsion system, sensors, and primary/secondary control systems

Author

A83-41909#

CARRIER LANDING SIMULATION RESULTS OF PRECISION FLIGHT PATH CONTROLLERS IN MANUAL AND AUTOMATIC APPROACH

R. NASTASI, P. MARTORELLA, R. HUFF, W. MCNEILL, and T. ZALESK (Grumman Aerospace Corp., Bethpage, NY) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 10 p (Contract N0021-79-C-0171; N00421-83-R-0069) (AIAA PAPER 83-2072)

A manned simulation of the F-14A aircraft was performed at NASA Ames Research Center to assess the effectiveness of Grumman-developed Precision Flight Path Control concepts, for both pilot and automatically controlled carrier landings, and to determine the influence that this new type of system has on flying qualities. A pilot comparison was made between the current Stability Augmentation System used for carrier landing approaches and a Precision Flight Path Control system. Also a performance comparison was made between the current Automatic Carrier Landing mode and a Precision Flight Path Control Automatic Carrier Landing system. It was demonstrated, for both the pilot and automatically controlled approaches, that Precision Flight Path Control systems designed to comply with a qualitative flight path control criteria reduced glide slope errors and pilot workload: this should lead to fewer bolters and waveoffs

Author

A83-42574#

AN OVERVIEW OF AIRBORNE OPTICAL COMMUNICATIONS

R. J. FELDMANN and J. C. HOLT (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 17-1-1 to 17-1-3. refs

The development of airborne communications is reviewed, the shortcomings of present airborne communications systems are examined, and the advantages of optical communications are discussed. The extreme directional capability of optical communications systems enables them to develop secure, low probability of intercept and antijam airborne terminals, and the inherent high frequencies of the optical spectrum permits a high data rate to be transmitted. Optical communication studies being undertaken in order to define the limits of operation and resolve technology issues are described and discussed.

C.D

A83-43696#

AIRBORNE RADAR TRACKING SYSTEM BASED ON OPTIMAL FILTERING THEORY

S. MAO (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol 4, March 1983, p. 62-72. In Chinese, with abstract in English. refs

A filtering theory is applied to the multiple closed-loop feedback system for tracking a single target in range, velocity, azimuth, and elevation using an airborne radar. The vector differential equation of the states used to control the four-tracking loop is established, and the corresponding nonlinear filtering algorithm is derived. Computer simulation results show that over a wide range a time-varying system using a Kalman filter performs better than a conventional system without an optimal filter. A nonlinear filtering system performs as well as a filtering one for steady state response, but achieves improved performance in transient response and error. Tracking loops coupled to each other via a Kalman filter perform better than separated loops. The system's performance is almost as good as an adoptive estimator which is sensitive to measurement noise. An aim coordinate system using this model is less sensitive to target maneuver

C D

A83-43713

A GROUND CONTROL SYSTEM FOR UMA

D. ALLEN and J. BENJAMIN (Royal Aircraft Establishment, Farnborough, Hants., England) IN: Remotely piloted vehicles, International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 25.1-25.4.

An RPV-controlling ground station is engaged in three main activities: mission planning, RPV control/mission execution, and RPV data interpretation and reporting. Operator workloads can be reduced in both mission planning and RPV control/mission execution functions through computer programming automation, as is presently described. The system presented can interface with a number of control systems as well as with any RPV, and is based on a desk top computer and digital plotting table. It may serve both as a simulator and as an active element in a flight testing program.

O C

A83-43714

PHOENIX GCS - SOME CONSIDERATIONS WHICH INFLUENCE THE DESIGN OF COMPUTER ASSISTED GROUND CONTROL STATIONS FOR RPV

E. J. H. COULSON, M. O. F. FAUSSET, and R. T. HUGHES (Ferranti Computer Systems, Ltd., Bracknell, Berks., England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 27.1-27.8.

The most important considerations in the design of an RPV-controlling ground station are the RPV's purpose and operational methods, the nature of communications (between the station and the RPV, on the one hand, and the ground station and its tasking authority, on the other), the types of sensors used,

and the crew size and crew skills required. Attention is drawn to the possibility that mission planning and sensor data analysis tasks may be carried out satisfactorily by a single person, if they are provided with some form of automated assistance to relieve the operator of routine tasks. Automation requirements are discussed, and it is noted that existing computer techniques may be satisfactorily applied. All tasks considered are rendered more tractable through the use of such devices as the Combined Map Electronic Display, which can superimpose sensor data on a map projection to facilitate interpretation. O C.

A83-43718

DIGITAL SIMULATION AND CONTROL OF THE MACHAN UMA
J. APLIN (Marconi Avionics, Ltd., Flight Automation Research Laboratory, Rochester, England) IN: Remotely piloted vehicles, International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 14.1-14.8 Research supported by the Ministry of Defence (Procurement Executive)

The Machan second-generation RPV has been designed as an all-digital system incorporating a digital on-board flight control system, digital strapdown attitude sensing, and digital outer loop control by way of a ground station. Attention is presently given to digital approach effects on overall system characteristics and capabilities, considering the implementation of control laws, preparation room and preflight testing of the RPV, the odlar software used in the ground control station's display and autopilot software, and RPV operation simulation practices employed in the course of development. O C.

A83-43722**A MULTI-FUNCTION RADAR SYSTEM FOR RPVS**

B. J. FOLEY (Thorn Emi Electronics, Ltd., Feltham, Middx., England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 24.1-24.11

Attention is given to a centimetric microwave radar system which, primarily employed as a navigation and landing aid, can provide a small, lightweight, low power-consumption multise radar for RPVs. The versatility of the radar has its basis in a unique signal processing technique which allows it to operate in a number of distinct roles simultaneously. Range measurement is accomplished entirely by Doppler signal analysis, which can be conducted in great detail in the security of a ground station by means of narrowband data link transmission. Doppler filtering conducted in this fashion can yield target separation even when many targets are present. O C.

A83-43723**A FLIGHT CONTROL AND NAVIGATION SYSTEM FOR SMALL RPVS**

I. S. MANT (Smiths Industries Aerospace and Defence Systems Co., Cheltenham, Glos., England) IN: Remotely piloted vehicles, International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 26.1-26.5 Research supported by the Ministry of Defence (Procurement Executive)

Strapdown sensors are exclusively used in the present RPV Flight Control and Navigation System, in conjunction with a digital processor, in order to minimize sensor costs and provide the RPV with full freedom of attitude without incurring such problems as gyro topping. System functions include pitch, roll and yaw stabilization, attitude hold, heading hold, height hold, navigation waypoints, and throttle control. The sensors used are three rate gyros, two accelerometers, a barometric altitude transducer, two Doppler units, and a three-axis magnetometer. O C.

N83-30368# Royal Aircraft Establishment, Farnborough (England) Aerodynamics Dept.

THE USE OF FREE-FLIGHT MODELS FOR THE PREDICTION OF DEPARTURE CONTROL

G. F. MOSS, A. J. ROSS, G. F. EDWARDS, and E. B. JEFFERIES. In AGARD Ground/Flight Test Tech. and Correlation 17 p. Feb 1983 refs

Avail: NTIS HC A23/MF A01

The importance of prediction techniques for the flight-dynamic behavior of proposed aircraft projects and in particular the use of the free flight model technique are discussed. Such free flight models are able to carry onboard flight control systems and can be used to evaluate stability augmentation and departure prevention methods. Examples of flight records of free flight tests are presented and compared with theoretical predictions and corresponding full scale data. A research program using HIRM, a high incidence research model configuration, is described which has as its central objective the widening of understanding of the flight dynamics phenomena of combat aircraft at high angles of attack. E.A.K.

N83-30400# Research Inst. of National Defence, Stockholm (Sweden) Dept. 2.

REPORT FROM THE INTERNATIONAL CONGRESS OF NAVIGATION

S. ARNZEN and E. SKARMAN. 13 Apr 1983. 45 p. In SWEDISH, ENGLISH summary. Held at Paris, 21-24 Sep 1982 (FOA-C-20489-E3, ISSN-0347-3694). Avail: NTIS HC A03/MF A01

Integrated navigation for sea and air applications was discussed. Sensor accuracy, laser gyroscopes, ship navigation processing system, MAN NAV with Decca, Das Azimuth, SAREL; DN Doppler, navigation for aircraft; DR integrated with Omega and with Loran, carrier aircraft inertial navigation, Kalman filter applications; integrated systems for helicopters, maritime data and control collision avoidance, safety at sea, and human factors were considered. Author (ESA)

N83-31590*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

FLIGHT DIRECTORS FOR STOL AIRCRAFT Final Report

U. H. RABIN. May 1983. 97 p. refs

(Contract NCC2-106)

(NASA-CR-166517, NAS 1.26.166517). Avail: NTIS HC A05/MF A01 CSCL 17G

Flight director logic for flight path and airspeed control of a powered-lift STOL aircraft in the approach, transition, and landing configurations are developed. The methods for flight director design are investigated. The first method is based on the Optimal Control Model (OCM) of the pilot. The second method, proposed here, uses a fixed dynamic model of the pilot in a state space formulation similar to that of the OCM, and includes a pilot work-load metric. Several design examples are presented with various aircraft, sensor, and control configurations. These examples show the strong impact of throttle effectiveness on the performance and pilot work-load associated with manual control of powered-lift aircraft during approach. Improved performance and reduced pilot work-load can be achieved by using direct-lift-control to increase throttle effectiveness. Author

N83-31591# Arinc Research Corp., Annapolis, Md.

COST DEVELOPMENT OF THE DUAL-CHANNEL GPS (GLOBAL POSITIONING SYSTEM) NAVIGATOR FOR GENERAL AVIATION APPLICATION Final Report

K. MARKIN and D. SWANN. Mar. 1983. 75 p. refs

(Contract DTFA01-80-C-10030)

(AD-A127157; DOT/FAA/ES-83/1; REPT-1378-51-6-2939). Avail: NTIS HC A04/MF A01 CSCL 05C

This report presents the methodology used and the results obtained in the avionics cost development of a dual-channel Global Positioning System (GPS) navigation set. The avionics design considered is currently undergoing technical evaluation at MIT Lincoln Laboratory. The cost of the navigation set was developed

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using an industry-accepted accounting method of cost estimating.
GRA

N83-31592# Mitre Corp., McLean, Va.
SOFTWARE DESCRIPTION FOR THE O'HARE RUNWAY CONFIGURATION MANAGEMENT SYSTEM. VOLUME 2: LOW-LEVEL PSEUDOCODE

S. KAVOUSSI Oct. 1982 443 p refs 2 Vol.
(Contract DTFA01-81-C-10003)
(AD-A127828; FAA-EM-82-28-VOL-2; MTR-82W125-VOL-2)
Avail: NTIS HC A19/MF A01 CSCL 17G

This document describes the software developed as part of the Chicago O'Hare Runway Configuration Management System (CMS). The software is designed as an interactive automated planning aid to assist the O'Hare assistant chief in the consistent selection of efficient runway configurations in order to lower aircraft delays. In addition, CMS serves as an information management system by consolidating various airport data and making them available for the O'Hare facility personnel. Volume 1 of this document contains the general description of the CMS software plus high level pseudocode describing its logic. Volume 2 is dedicated to detailed description of the software via low level pseudocode.
Author (GRA)

N83-31593# Sandia Labs., Albuquerque, N Mex
WELLBORNE INERTIAL NAVIGATION SYSTEM
J. R. KELSEY 1983 23 p refs Presented at the IADC/SPE Drilling Conf, New Orleans, 20 Feb 1983
(Contract DE-AC04-76DP-00789)
(DE83-004012; SAND-82-1711C; CONF-830203-2) Avail: NTIS HC A02/MF A01

A phototype wireline tool which includes a downhole inertial platform and a surface computer to spatially map a well is described. The hardware consists of a single-gimbaled inertial platform with accelerometers and gyros to obtain three-axis motion information. The gyroscope and accelerometer outputs are transmitted to a computer at the surface which calculates probe attitude relative to north, east, and vertical. Double integration of the accelerometer data provides the position information. A conventional 7-conductor wireline is used for the system data transmission. System accuracy is enhanced by advances made in the computer software which processed the data received from the tool. The software uses statistical sampling estimation to obtain optimal estimates of the system errors. Measurement errors are determined by periodically stopping the tool during the logging procedure and observing the indicated velocity measurements.
Author

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A83-41039#
F/A-18 INLET/ENGINE COMPATIBILITY FLIGHT TEST RESULTS

N F AMIN (Northrop Corp., Hawthorne, CA) and D J HOLLWEGER (McDonnell Douglas Corp., St Louis, MO) Journal of Aircraft (ISSN 0021-8669), vol 20, Aug 1983, p. 641-649

Previously cited in issue 19, p. 3266, Accession no. A81-40860

A83-41044#

FINITE-ELEMENT ANALYSIS OF THE T-38 CANOPY

R. A. SMITH and R. E. MCCARTY (USAF, Wnght Aeronautical Laboratories, Wright-Patterson AFB, OH) (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers, Part 1, p. 197-205) Journal of Aircraft (ISSN 0021-8669), vol. 20, Aug. 1983, p. 682-688. refs

Previously cited in issue 13, p. 2020, Accession no. A82-30096

A83-41045#

DURABILITY AND DAMAGE TOLERANCE CONTROL PLANS FOR U.S. AIR FORCE AIRCRAFT

M. A. LANDY and O. L. SMITHERS (USAF, Aeronautical Systems Div., Wnght-Patterson AFB, OH) (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers, Part 2, p. 166-174) Journal of Aircraft (ISSN 0021-8669), vol. 20, Aug 1983, p. 689-695. refs

Previously cited in issue 13, p. 2021, Accession no. A82-30147

A83-41046#

RIGID-BODY STRUCTURAL MODE COUPLING ON A FORWARD SWEEP WING AIRCRAFT

G. D. MILLER, J. H. WYKES, and M. J. BROSNAN (Rockwell International Corp., El Segundo, CA) (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers, Part 2, p. 201-208) Journal of Aircraft (ISSN 0021-8669), vol. 20, Aug 1983, p. 696-702 refs

Previously cited in issue 13, p. 2022, Accession no. A82-30150

A83-41076

BLADE DESIGN FOR REDUCED HELICOPTER VIBRATION

R. H. BLACKWELL, JR. (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 33-41. refs

The sensitivity of the vibratory hub loads of a four-bladed articulated rotor to variations in blade parameter are investigated through analysis and examination of model and full scale test data. Parameters examined include blade stiffness, spanwise mass distribution, chordwise offset of center-of-gravity and aerodynamic center axes, twist, tip sweep and airfoil camber. Analytic results show reduced vibratory hub loading for particular combinations of spanwise mass distribution and chordwise c.g.-a.c. offset. Little sensitivity of vibration to twist is predicted. Model test results show 20 to 35 percent reductions in 4P hub forces and moments with the addition of tip sweep. Twenty to 50 percent reductions in 4P hub loads were measured on model blades having noseup section pitching moment. The paper attempts to determine the mechanism responsible for the observed vibration reductions so that the results can be extended to other blade designs.
Author

A83-41077

ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF A BEARINGLESS HUB-ABSORBER

S. P. VISWANATHAN and R. D. MCCLURE (Bell Helicopter Textron, Fort Worth, TX) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 47-55. refs

A centrifugal pendulum absorber has been developed which employs mercury as the tuning weight. The mercury works inside a totally sealed cylindrical container. Whirl-shake-tests have established its dynamic similarity to the well known bifilar and simple pendulums. Flight tests performed on Bell Helicopter Models 206LM and 412 show that the mercury pendulum absorbers are effective in reducing cabin vibration. Analytical methods have been presented for predicting rotor response, pendulum absorber forces, hub and fuselage responses while the helicopter is in a low-speed transitional flight regime (flare). The analysis shows satisfactory

correlation to flight-test results both with and without the mercury pendulum absorbers. Author

A83-41080

LHX SYSTEM DESIGN FOR IMPROVED PERFORMANCE AND AFFORDABILITY

G R MARNER (U.S. Army, Army Aviation Research and Development Command, St. Louis, MO) and R R PRUYN (Boeing Vertol Co., Philadelphia, PA) (European Rotorcraft Forum, 8th, Aix-en-Provence, France, Aug. 31-Sept. 3, 1982) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 71-78.

A system design that can provide extraordinary avionics reliability for the LHX aircraft has been devised. This system includes self-healing components, functional and conventional redundancies, and reconfigurable features. There is little weight and cost increase over a conventional avionics installation since some components were eliminated and conventional redundancy was used only in selected situations. Supporting analyses show that LHX needs high reliability if it is to be affordable. New approaches are required since LHX must be more capable than present aircraft. More sensors, target-acquisition aids, and better navigation and communications systems are required. These systems must be effective in reducing crew workload. These systems must also be unusually reliable; with today's technology, they would cause an unacceptable failure rate and an impossible maintenance burden. The avionics architecture suggested for LHX has the potential for avoiding these drawbacks and, in fact, can provide increased utilization. When combined with the functional improvements furnished by the new sensors, the reliability of the LHX will provide high productivity. Author

A83-41081

THE USE OF ACTUATOR-DISC DYNAMIC INFLOW FOR HELICOPTER FLAP-LAG STABILITY

G. H. GAONKAR (Indian Institute of Science, Bangalore, India), J. NAGABHUSHANAM (Hindustan Aeronautics, Ltd., Bangalore, India), D. A. PETERS (Washington University, St. Louis, MO), V. V. S. SASTRY, and T. S. R. REDDY (European Rotorcraft Forum, 8th, Aix-en-Provence, France, Aug. 31-Sept. 3, 1982) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 79-88 refs (Contract NSF CME-79-06304)

A hierarchy of thirteen unsteady and quasi-steady inflow models is used for prediction of flap-lag damping in hover and in forward flight. It includes variations in inflow model that range from a simple, lift-deficiency function to a dynamic, five-degree-of-freedom inflow model. The models are based on two general inflow formulations. The first formulation is a time-delayed, unsteady momentum theory with a first-harmonic description of inflow. The second formulation is an unsteady, actuator-disc theory with both first- and second-harmonic variations in inflow. Based on previous analyses, the first-harmonic, unsteady actuator-disc theory is known to be reasonably accurate, thus providing an objective measure for comparison. The results show an interesting relationship between the number of blades on a rotor and the choice of the inflow model to be used. Author

A83-41320

FROGFOOT - A NEW SHTURMOVNIK ON TRIAL

B. SWEETMAN (Interavia (ISSN 0020-5168), vol. 38, Aug. 1983, p. 830-832)

Consideration is given to the probable design features and performance characteristics of the Soviet Sukhoi-25 ground support aircraft, designated 'Frogfoot' by NATO, which has since early 1982 been operational against insurgents in Afghanistan. The Su-25 is believed to carry an internal 30 mm-caliber multibarrel cannon, and to be powered by turbojet engines derived from MIG-21 Turbansky designs, without afterburners. The use of two such engines, widely separated and located at mid-fuselage, is probably prompted by considerations of survivability. Extensive comparisons are presently made with the larger U.S. Air Force ground support aircraft, the A-10A Thunderbolt II, as well as with such

already-deployed Soviet fighter-bombers as the Su-20, Su-27, and MIG-27. An important possible reason for the small production run of Su-25s is the formation of Army Aviation, whose units have been equipped with the highly successful Mi-24 attack helicopter. O.C.

A83-41660*# Boeing Military Airplane Development, Seattle, Wash.

INTEGRATED AIRFRAME/PROPULSION CONTROL SYSTEM ARCHITECTURES (IAPSA) STUDY

STERN, A. D. (Boeing Military Airplane Co., Seattle, WA) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 1-13. refs (Contract NAS1-16942) (AIAA PAPER 83-2158)

Three integrated airframe/propulsion control system (ACS) architectures have been developed and are discussed. The baseline is a state of the art design which integrates autonomous propulsion control and airframe flight control systems. Two alternate ACSs for the 1990s using emerging technologies were developed and are compared with each other and the baseline. One of these, designated D/D, uses parallel distributed processing, while the other, designated C/D, centralizes the processing into two centrally located redundant electronics complex. The C/D system locates all redundant computing elements and interfacing electronics in two boxes with optical sensor and actuation devices optically connected to the two boxes. Evaluation reveals the C/D architecture to be better than the other two in five of ten categories; D/D is superior in only two of the ten. C/D

A83-41686#

ADAPTIVE CONTROL OF VARIABLE FLOW DUCTED ROCKETS

F. GOLDSTEIN (Dynamics Research Corp., Wilmington, MA) and A. J. CALISE (Drexel University, Philadelphia, PA) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 274-282 (AIAA PAPER 83-2202)

Two variable flow ducted rocket (VFDR) control laws are reviewed and used to examine missile performance for different missions. Side-dump inlets provide the variable flow characteristics of the ramjet propulsion system. Aerodynamic lift and drag data were considered in the simulation model, together with engagement scenarios for co-altitude, low altitude, and high altitude. Optimized guidance and control laws are defined for a cruise condition, climb and descent, lift and thrust, and the angle of attack compensation. Attention is given to the turn-down ratio constraint, and the counterpart parameters from a conventional control law. Performance of the missile was evaluated for the time/fuel trajectory, the F-pole, and altitude launch capability regions. Optimal control techniques were shown to significantly extend range with a relaxation of the turn-down ratio constraint. M.S.K.

A83-41688#

CONTROL LAW DESIGN FOR EJECTION SEATS

J. V. CARROLL (Scientific Systems, Inc., Cambridge, MA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 302-310. USAF-supported research refs (AIAA PAPER 83-2204)

A multivariable, nonlinear synthesis approach is presented for designing the control laws for fighter aircraft using the survival of the crewmember as the governing criterion. The method is based on prestored optimal nonlinear reference solutions, acceleration control, and an on-board predictive model for implementation in a self-contained mode. Feedback control laws are defined by decoupling the ejection seat dynamics with respect to I/O pair such as velocity, angle of attack, sideslip, etc. An algorithm is defined that is robust in response to initial seat conditions. It is concluded that a vectored thrust ejection seat control laws are

feasible provided the aerodynamic data are modelled by spherical harmonic coefficient approximations. It is assumed that a high energy ejection seat will be equipped with a deployable fin, and that disturbance rejection will be incorporated in the laws

M S K.

A83-41689#

THE AIR FORCE EJECTION SEAT AS A VEHICLE FOR DIGITAL FLIGHT CONTROL

L. A. JINES (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 311-317. refs

(AIAA PAPER 83-2205)

The standard Air Force ejection seat escape system is a vehicle which possesses unique dynamic characteristics designed for an operational life saving mission within a challenging aerodynamic envelope. The combination of ejection seat equations of motion, aerodynamic properties, and quantitative human tolerance data allows for a definition of a unique aerospace vehicle as a candidate for modern control theory design techniques. The successful application of these techniques shall yield a system design which incorporates vectored thrust digital flight control to improve ejection seat performance while operating within human tolerance limits

Author

A83-41698#

IMPACT OF AIRCRAFT STRUCTURAL DYNAMICS ON INTEGRATED CONTROL DESIGN

T. YAMAMOTO (Rockwell International Corp., El Segundo, CA) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 386-390. refs

The flexible, lightweight, high-performance wing of Rockwell's forward swept wing (FSW) fighter demonstrator exhibits rigid body/wing bending coupling characteristics. The design integration of active control of the aerostructural coupling into the FSW digital fly-by-wire flight management system is described. Various design considerations such as the interaction with the stability augmentation system, the effect of filters, and sample and hold for digital systems on the active control and control power requirements are presented.

Author

A83-41715*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

OPTIMAL SYMMETRIC FLIGHT WITH AN INTERMEDIATE VEHICLE MODEL

H. J. KELLEY, E. M. CLIFF (Virginia Polytechnic Institute and State University, Blacksburg, VA), and P. K. A. MENON IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 548-558. refs

(Contract NAG1-203)

(AIAA PAPER 83-2238)

The present investigation is concerned with an examination of optimal symmetry flight on the basis of the intermediate vehicle model. The analysis is partly based upon an exploration of Euler solutions for the path-angle-as-control model carried out by Kelley (1958). The current analysis takes into account higher-order optimality conditions and 'chattering-control' phenomena. Attention is given to details regarding the intermediate vehicle model, the Legendre-Clebsch necessary condition, the conjugate-point test, and the numerical solution of the time-range problem. It is found that the flight path angle takes on the role of control variable in the model. From physical considerations, it can be seen that when a positive margin of thrust over drag exists, the maximum-range climb trajectory without time or fuel constraints has no proper maximum nor an upper bound.

G.R.

A83-41901#

THE IMPACT OF COMPUTATIONAL AERODYNAMICS ON AIRCRAFT DESIGN

P. E. RUBBERT and E. N. TINOCO (Boeing Co., Seattle, WA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983 9 p. refs

(AIAA PAPER 83-2060)

The impact of computational fluid dynamics (CFD) on aerodynamic design capabilities and design organization and performance are discussed. CFD is of greater use to the design of commercial aircraft than military aircraft due to the attached flow conditions readily covered by CFD's accounting for only 15 percent of the military fighter plane flight envelope. It is still essential, however, that designers have the experience to realize the areas of the physics of flows that are not yet describable with CFD. A team of researchers is at times used to interface between the designer and testing to provide feedback on the results of projections, and also to define the limitations of the data available in wind tunnel trials. CFD permits investigation of innovative designs, such as close-coupled nacelle configurations, and also reduction of the necessary design time. A growth in the aerospace industry's need for PhD mathematical programmers is projected.

M.S.K.

A83-41903#

COMPUTATIONAL AERODYNAMIC DESIGN OF FIGHTER AIRCRAFT: PROGRESS AND PITFALLS

R. G. BRADLEY and I. C. BHATELEY (General Dynamics Corp., Fort Worth, TX) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 9 p. refs

(AIAA PAPER 83-2063)

The potentials for application of computational fluid dynamics (CFD) to fighter aircraft are explored and compared with data available from wind tunnel trails. It is shown that CFD is a means to avoid considerable wind tunnel testing, although significant improvements are needed to adequately model complex flows in transonic and supersonic flight, as well as complex aircraft geometries. However, detailed flowfield physics are describable with CFD at the same time that the measurement capabilities are not available in wind tunnels. CFD design involves solutions to the Laplace or Prandtl-Glauert equations by means of panel, collocation, vortex lattice, and higher-order panel methods. Finite difference methods are being introduced for solutions in the transonic regime, and CFD solutions for the Navier-Stokes equations are under development. It is recommended that CFD application involve the formation of research teams for CFD design, wind tunnel testing, and a team to provide an interface between the two for feedback and analyses.

M.S.K.

A83-41919*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

APPLICATIONS OF STATE ESTIMATION IN AIRCRAFT FLIGHT-DATA ANALYSIS

R. E. BACH, JR. and R. C. WINGROVE (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 11 p. refs

(AIAA PAPER 83-2087)

This paper traces the evolution of the use of state estimation in the analysis of aircraft flight data and discusses some recent applications associated with airline turbulence upsets and high-angle-of-attack flight tests. A unifying mathematical framework for state estimation is reviewed, and several examples are shown that illustrate a general approach for estimating variables that are difficult to measure. It is hoped that the diversity of the applications discussed and the examples presented will make the flight-data analyst mindful of the potential advantages of using state estimation methods.

Author

A83-41928*# Systems Control Technology, Inc., Palo Alto, Calif

FILTERING FLIGHT DATA PRIOR TO AERODYNAMIC SYSTEM IDENTIFICATION

T. L. TRANKLE and U. H. RABIN (Systems Control Technology, Inc., Palo Alto, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 10 p. Sponsorship U.S. Maritime Administration. refs

(Contract MARAD-MA-80-SAC-0192; NAS2-11391; N00024-80-C-5375)

(AIAA PAPER 83-2098)

An algorithm for processing flight-test data to provide state estimates and instrument calibrations for aerodynamic or hydrodynamic system identification by the equation error estimation method is developed and demonstrated on synthesized data. The extended-Kalman-filter algorithm employs a locally level, north-pointing frame of reference, accounts for rotating ellipsoidal earth effects, and estimates sensor bias, scale factors, wind components, and process noise levels by maximum-likelihood parameters. The method is found to be most effective with navigation quality inertial input data. The algorithm is applied to data from a six-degree-of-freedom F-4 aircraft simulation and shown to produce state estimates in good agreement with the simulation values.

T.K

A83-41929#

IDENTIFICATION OF AERODYNAMIC COEFFICIENTS USING FLIGHT TESTING DATA

R. F. STENGEL (Princeton University, Princeton, NJ) and C. FRATTER (American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 12 p. refs

(AIAA PAPER 83-2099)

A nonlinear aerodynamic model of Princeton University's Avionics Research Aircraft has been identified by applying the Estimation-Before-Modeling (EBM) technique to flight testing data. The model is applicable over an angle-of-attack range of 0 to 15 deg and a sideslip angle range of + or - 10 deg, and it contains static, dynamic, and unsteady aerodynamic effects. Comparison with prior flight testing and full-scale wind tunnel results suggests that the EBM-derived data are comparable to the wind tunnel data (which are limited to static coefficients) and more comprehensive than the earlier flight testing data. Novel aspects of the research include the use of quaternions in system identification and the use of a multiprocessor data acquisition system.

Author

A83-41946*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

INTERCEPTION IN THREE DIMENSIONS - AN ENERGY FORMULATION

N. RAJAN and M. D. ARDEMA (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 12 p. refs

(AIAA PAPER 83-2121)

The problem of minimum-time interception of a target flying in three dimensional space is analyzed with the interceptor aircraft modeled through energy-state approximation. A coordinate transformation that uncouples the interceptor's extremals from the target motion in an open-loop sense is introduced, and the necessary conditions for optimality and the optimal controls are derived. Example extremals are shown.

Author

A83-41948#

FLIGHT PATH/NOSE POINTING - A REQUIRED CRITERION IN FUTURE FIGHTER AIRCRAFT DESIGN

B. TAMRAT (Northrop Corp., Aircraft Div., Hawthorne, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983 6 p.

(AIAA PAPER 83-2123)

Modern fighter aircraft use sophisticated all-aspect missiles as a primary air-to-air weapon. As missile effectiveness improves, the need to design aircraft which take into account the optimum use of these weapon systems is apparent. In this study Load Factor/Lift Limited maneuvers in the vertical plane are analyzed in light of achieving flight path pointing. The results show that there is an optimum wing loading for best pointing margin. Maximum load factor capability and maximum lift coefficient must be maximized. Low wing loading improves pointing capability when used with thrust reversal. It is concluded that a pointing criterion can be considered in addition to the classical design criteria in future fighter aircraft design.

Author

A83-41952#

INNOVATIVE CONCEPTS FOR TACTICAL STOL

G. J. ECKARD (Boeing Military Airplane Co., Seattle, WA) and G. E. POTH (USAF, Aeronautical Laboratories, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 21 p.

(AIAA PAPER 83-2129)

Utilization of innovative and conventional thrust vectoring moment balance mechanisms in an advanced tactical fighter application was examined in a detailed and consistent analysis. Innovative mechanisms investigated included thrust line translation, lift line translation and auxiliary power control. Conventional mechanisms included horizontal tails and canards. Maneuverability, supersonic persistence and STOL capability were among the driving requirements in the analyses. Negative stability is one of several technologies that was actively pursued to increase weapon system effectiveness. Lift engines used as STOL moment trim devices, evolved as an attractive concept. The investigation led to the comparison of several unique fighter configurations.

Author

A83-41958*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

SEPARATION OF TIME SCALES IN AIRCRAFT TRAJECTORY OPTIMIZATION

M. D. ARDEMA and N. RAJAN (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 8 p. refs

(AIAA PAPER 83-2136)

Two methods for analyzing the time-scale properties of aircraft trajectory optimization problems are presented. Time-scale properties must be identified before solutions can be obtained by using singular perturbation methods. Both methods only require a knowledge of the state equations, the aircraft characteristics, and the bounds on the state and control variables. Although these methods give only rough estimates of time-scale separation, they do not require that an 'exact' optimal trajectory be known, as do the more rigorous methods, and they are an improvement on the ad hoc methods currently in use. The two methods are applied to an example problem for a high performance aircraft.

Author

A83-41959*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

THE APPLICATION AND RESULTS OF A NEW FLIGHT TEST TECHNIQUE

E. L. DUKE and D. P. LUX (NASA, Flight Research Center, Edwards, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 12 p.
(AIAA PAPER 83-2137)

The application of a flight test maneuver auto-pilot test technique for collecting aerodynamic and structural flight research data on a highly maneuverable aircraft is described. This newly developed flight test technique was applied at the Dryden Flight Research Facility of the NASA Ames Research Center on the highly maneuverable aircraft technology (HiMAT) vehicle. A primary flight experiment was done to verify the design techniques used to develop the HiMAT aerodynamics and structures. This required the collection of large quantities of high-quality pressure distribution, loads, and deflection data. The effectiveness of the flight test technique is illustrated with a flight test example comparing various pressure distribution measurements. Author

A83-41960*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

ENERGY STATE REVISITED

H. J. KELLEY, E. M. CLIFF, and A. R. WESTON (Virginia Polytechnic Institute and State University, Blacksburg, VA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 6 p. refs

(Contract NAG1-203)

(AIAA PAPER 83-2138)

Kaiser (1944) has introduced the concept of 'resultant height' in connection with aircraft minimum-time climbs. Its use as a state variable in trajectory work is attractive because it is a 'slower' variable than either altitude or velocity. Kelley (1972, 1973) has made an attempt to synthesize 'slow' state variables in connection with singular-perturbation procedures. In the present investigation, attempts are made to synthesize both 'fast' and 'slow' variables for the minimum-time-to-climb problem along lines explored by Kelley. Attention is given to climb equations, energy-modeling simplifications, 'slow'-variable choice, 'fast'-variable-choice considerations, a singular-perturbation analysis, the choice of a 'fast' variable, and the climb-dash problem. G.R.

A83-41962*# Cincinnati Univ., Ohio.

OPTIMAL SHORT RANGE TRAJECTORIES FOR HELICOPTERS

G. L. SLATER (Cincinnati, University, Cincinnati, OH) and H. ERZBERGER (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 11 p. refs

(Contract NAG2-175)

(AIAA PAPER 83-2140)

An optimal flight path algorithm using a simplified altitude state model and an apron climb-cruise-descent flight profile has been developed and applied to determine minimum fuel and minimum cost trajectories for a helicopter flying a fixed range trajectory. The performance model is based on standard flight manual data and is such that on-line trajectory optimization is feasible with a relatively small computer. The results show that the optimal flight path and optimal cruise altitude can represent a 10 percent fuel saving on a minimum fuel trajectory. The optimal trajectories show considerable variability due to helicopter weight, ambient winds and the relative cost trade-off between time and fuel. In general, 'reasonable' variations from the optimal velocities and cruise altitudes do not significantly degrade the optimal cost. Author

A83-41963*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PARAMETRIC STUDY OF CRITICAL CONSTRAINTS FOR A CANARD CONFIGURED MEDIUM RANGE TRANSPORT USING CONCEPTUAL DESIGN OPTIMIZATION

P. D. ARBUCKLE and S. M. SLIWA (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 12 p. refs
(AIAA PAPER 83-2141)

Constrained parameter optimization was used to perform optimal conceptual design of both canard and conventional configurations of a medium range transport. A number of design constants and design constraints were systematically varied to compare the sensitivities of canard and conventional configurations to a variety of technology assumptions. Main landing gear location and horizontal stabilizer high-lift performance were identified as critical design parameters for a statically stable, subsonic canard transport. Author

A83-42128

CALCULATION OF THE FLOW RATE CHARACTERISTIC OF A JET-THROTTLING HYDRAULIC DISTRIBUTOR WITH ALLOWANCE FOR THE EJECTION PROPERTIES OF A TUBE-PLATE SYSTEM [K RASCHETU RASKHODNOI KHARAKTERISTIKI STRUINO-DROSSEL'NOGO GIDRORASPREDELITELIA S UCHETOM EZHEKSIONNYKH SVOISTV SISTEMY 'TRUBKA-PLATA']

A. I. BAZHENOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 16-20. In Russian.

An equivalent substitution circuit is used to derive an analytical expression for the flow rate characteristic of a jet-throttling hydraulic distributor with four variable conductivities. Experimentally determined ejection coefficients are presented for tube-plate systems of various design parameters. The effect of the ejection characteristics on the nonlinearity of the flow rate characteristic of a hydraulic distributor is discussed. V.L.

A83-42533#

F/RF-4 TRANSPARENCY BASELINE BIRD IMPACT TEST PROGRAM

G. J. STENGER (Dayton, University, Dayton, OH) and R. J. SIMMONS (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 2-7-1 to 2-7-5.
(Contract F33615-80-C-3401)

Birdstrikes to the crew enclosures of USAF F-4 aircraft have resulted in major aircraft damages coupled with severe/fatal pilot injuries. A program has been initiated to develop a transparency system for the F-4 aircraft with four-pound, 500-knot capability. The first step in this program was to experimentally determine the existing capability by impact testing full scale flight hardware at eight locations on the test canopy with four-pound birds. Tests on experimental, 'Bird proof' windshield side panels have been conducted at 450 knots and resulted in failure of the windshield frame. The baseline birdstrike test results are summarized in a capability diagram. Author

A83-42567#

STATE SPACE MODEL CONCEPT FOR EVALUATING SURVIVABILITY METHODOLOGIES FOR AIRCRAFT DESIGN

E. J. BEDNARZ and A. R. DEWISPELARE (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 14-4-1 to 14-4-5. refs

A state space model, consisting of fifteen state variables and fourteen performance indices, is used to describe and evaluate survivability methodologies for aircraft design. These state variables uniquely describe the different analyses, physical laws, missions,

threats, and vehicle subsystems considered within a general survivability methodology. The performance indices, expressed in equation form as functions of the state variables, measure a methodology's performance with respect to the attributes of completeness, validity, cost to use, and flexibility. These results are useful in selecting an optimal survivability methodology based upon a particular set of requirements. Author

A83-42808

THE IN-SERVICE FLIGHT TESTING OF SOME CARBON FIBRE-REINFORCED PLASTIC COMPONENTS

R. E. ELLIS and A. J. MASON (British Aerospace Public, Ltd., Co., Weybridge, Surrey, England) (Imperial College of Science and Technology, Royal Aircraft Establishment, Carr Reinforcements, et al., Symposium on Environmental Effects on Fibre-reinforced Plastics, London, England, July 12, 13, 1983) Composites (ISSN 0010-4361), vol. 14, July 1983, p. 233-236. Research supported by the Royal Aircraft Establishment and British Airways.

The effects on 'in-service' operating conditions on the physical properties of some carbon fiber-reinforced composite materials have been assessed by flight testing carbon fiber-reinforced plastic airframe components for periods of up to five years and 10,590 flying hours. These components were elements of an aircraft's external skin and were fabricated using unidirectional and cross-ply configurations. Single skin and 'honeycomb sandwich' constructions were employed. Test parameters monitored, using laboratory control components, included interlaminar shear strength, flexural and tensile properties. Little or no appreciable deterioration of these properties was exhibited. Author

A83-42888

DEVELOPMENT OF A MATHEMATICAL MODEL OF A FLIGHT VEHICLE AND THE EXPERIMENTAL VERIFICATION OF ITS RELIABILITY [O SOZDANII MATEMATICHESKOI MODELI LETATEL'NOGO APPARATA I EKSPERIMENTAL'NOI PROVERKE EE DOSTOVERYOSTI]

S. M. BELOTSEKOVSKII and I. U. B. KULIFEEV. IN: Problems of mechanics and heat transfer in space technology. Moscow, Izdatel'stvo Mashinostroenie, 1982, p. 162-175. In Russian. refs.

A general approach to the development of the mathematical model of a flight vehicle is examined in which logico-analytical investigations determine the general structure of the model while numerical methods of aerodynamics and structural mechanics provide the main source of information about model parameters. Statistical criteria are proposed for verifying whether the model is consistent with data of physical experiments, and procedures for the application of these criteria are described. Appropriate examples are presented on the basis of data of physical and numerical experiments; particular emphasis is placed on a numerical experiment checking the consistency of a model of the short-period lateral motion of a flight vehicle. B. J.

A83-43317

AUTOGAS FLIGHT TEST IN A CESSNA 150 AIRPLANE

H. ZEISLOFT (Experimental Aircraft Association, Inc., Hales Corners, WI) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 27 p. 7. (SAE PAPER 830706)

Because of the availability and cost problems in supplying 80 grade aviation gas to the users, and because of the high maintenance costs and lowered reliability when using 100LL aviation gasoline in 80 octane, aircraft engines, flight tests were conducted to determine airworthiness of the aircraft and compliance with Federal Air Regulations when using automobile gasoline. On the basis of these tests, FAA approval has been given for the use of unleaded regular automobile gasoline for all Cessna 150 airplanes powered with Teledyne Continental Motors 100 hp engines. No changes were required to the airframe, engine or operation of the aircraft. Author

A83-43320

UNCONVENTIONAL COMMUTER CONFIGURATIONS - A DESIGN INVESTIGATION

R. SRIVATSAN and J. ROSKAM (Kansas, University, Lawrence, KS) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 18 p. refs. (SAE PAPER 830710)

The results of a design investigation of some unconventional airplane configurations are reported in this paper. The viability of designing canard and 3-surface airplanes to meet commuter airline needs was investigated. This study was conducted on an airplane designed to carry 30 passengers on 600 n.m. stage lengths, cruising at 0.6 Mach number at an altitude of 28,000 feet. A test ride quality evaluation was also carried out. This indicated that, although considerable performance improvement was possible over existing airplanes of the same type, active ride augmentation systems were needed to achieve airliner levels of comfort. All three airplanes looked good in terms of mission fuel consumption and climb terms. The 3-surface configuration managed to edge out the other two in those same terms. Author

A83-43322

DESIGN CONSIDERATION FOR LIGHTING MODERN COMMERCIAL AIRCRAFT

P. H. GREENLEE (Midland Ross Corp., Urbana, OH) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 9 p. (SAE PAPER 830712)

The configuration of high performance modern commercial aircraft vary considerably from one model to another. The location and design of lighting fixtures, particularly for exterior lighting, are affected significantly by these configuration differences. It is important to consider lighting during the early design stages of the airplane to maximize quality and usefulness of the resulting lighting systems. Lighting plays an important part in aircraft safety, crew performance and passenger comfort. Author

A83-43326* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. FLIGHT INVESTIGATION OF NATURAL LAMINAR FLOW ON THE BELLANCA SKYROCKET II

B. J. HOLMES (NASA, Langley Research Center, Hampton, VA), C. J. OBARA (Kenton International, Inc., Hampton, VA), G. M. GREGOREK, M. J. HOFFMAN, and R. J. FREUHLER (Ohio State University, Columbus, OH) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 16 p. refs. (SAE PAPER 830717)

Two major concerns have inhibited the use of natural laminar flow (NLF) for viscous drag reduction on production aircraft. These are the concerns of achievability of NLF on practical airframe surfaces, and maintainability in operating environments. Previous research in this area left a mixture of positive and negative conclusions regarding these concerns. While early (pre-1950) airframe construction methods could not achieve NLF criteria for waviness, several modern construction methods (composites for example) can achieve the required smoothness. This paper presents flight experiment data on the achievability and maintainability of NLF on a high-performance, single-propeller, composite airplane, the Bellanca Skyrocket II. The significant contribution of laminar flow to the performance of this airplane was measured. Observations of laminar flow in the propeller slipstream are discussed, as are the effects of insect contamination on the wing. These observations have resulted in a new appreciation of the operational feasibility for achieving and maintaining NLF on modern airframe surfaces. Author

A83-43330* National Aeronautics and Space Administration Langley Research Center, Hampton, Va.
OBSERVATIONS OF SEVERE IN-FLIGHT ENVIRONMENTS ON AIRPLANE COMPOSITE STRUCTURAL COMPONENTS
 W. E. HOWELL and B. D. FISHER (NASA, Langley Research Center, Hampton, VA) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983, Paper. 10 p. refs

The development of relatively inexpensive, highly sophisticated avionics systems makes it now possible for general aviation aircraft to fly under more severe weather conditions than formerly. Increased instrument flying increases exposure of aircraft to potentially severe thunderstorm activity such as high rain rates, hail stones, and lightning strikes. In particular, the effects of lightning on aircraft can be catastrophic. Interest in aircraft lightning protection has been stimulated by the introduction of advanced composites as an aircraft structural material. The present investigation has the objective to report experiences with three composite components which have flown in thunderstorms, taking into account three F-106B composite fin caps. The only visible lightning strike damage to a flame sprayed aluminum coated glass/epoxy fin cap was a small area of the aluminum which was burned. Visible lightning strike damage to a Kevlar/epoxy fin cap was limited to the exterior ply of aluminum coated glass fabric. In the case of a graphite/epoxy fin cap, lightning currents could be conducted. G.R.

A83-43673* California Univ., Los Angeles
FORMULATION AND SOLUTION OF ROTARY-WING AEROELASTIC STABILITY AND RESPONSE PROBLEMS
 P. P. FRIEDMANN (California, University, Los Angeles, CA) Vertica (ISSN 0360-5450), vol. 7, no. 2, 1983, p. 101-141 Army-supported research. refs
 (Contract NSG-1578)

The state of the art in the formulation and solution of rotary-wing aeroelastic stability and response problems is reviewed in detail. The approximations used in the structural, inertia and aerodynamic operators are discussed. The important role of geometric nonlinearities, due to moderate deflections, and aerodynamic stall in the aeroelastic stability and response problem are identified. It is also shown that geometric nonlinearities are of primary importance in aeroelastic stability calculations, and have a more limited, though important, role in response calculations. Next, formulation of coupled rotor/fuselage problems is described, for both air and ground resonance type problems. Both topics, the isolated blade problem and the coupled rotor/fuselage problem, are treated for both hover and forward flight. Solution of aeroelastic stability and response problems proceeds in two stages. First, the spatial dependence is eliminated by using Galerkin's method, or by using the finite element method. Next the nonlinear, or linear, ordinary differential equation with periodic coefficients have to be solved for stability or response. Efficient numerical methods for accomplishing these objectives are presented in a comprehensive manner. The paper contains a number of illustrative numerical results which are intended to clarify various aspects of the modeling process and serve as representative results for both aeroelastic stability and response calculations for a variety of blade and rotor configurations. Author

A83-43674
INVESTIGATIONS OF HINGELESS ROTOR STABILITY
 R. A. ORMISTON (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) Vertica (ISSN 0360-5450), vol. 7, no. 2, 1983, p. 143-181. refs

An overview of the technical development of hingeless and bearingless rotors is given, with emphasis on aeroelastic and aeromechanical stability characteristics. Important considerations for theoretical analysis are discussed. Theoretical and experimental investigations of isolated blade flap-lag and flap-lag-torsion stability, and coupled rotor-body aeromechanical stability are described. Physical interpretation and important rotor system design parameters are emphasized. An overview of bearingless rotor dynamics is also included. Author

A83-43700
REMOTELY PILOTED VEHICLES; INTERNATIONAL CONFERENCE, 3RD, BRISTOL, ENGLAND, SEPTEMBER 13-15, 1982, PROCEEDINGS AND SUPPLEMENTARY PAPERS
 Conference sponsored by the Royal Aeronautical Society and University of Bristol. Bristol, University of Bristol, 1982, p. Proceedings, 174 p; Supplementary Papers, 85 p

The present conference on remotely piloted vehicles (RPVs) covers their operational requirements and philosophy, airframe and propulsion subsystems, payloads, navigation systems, ground control, and launch and recovery methods. Among the topics discussed are the assessment of RPV operational effectiveness, rocket-boosted and low signature RPV designs, reconnaissance and surveillance systems such as the CL 289, R-4E, Scout, ASAT, and Aquila RPVs, the use of gyroscopes aboard RPVs, small RPV aerodynamics, and brushless generators for RPV onboard electrical generation. Also discussed are low cost, expendable turbojet engines, lightweight piston engines, pyroelectric and thermal imaging sensors, RPV multifunction radar, RPV flight control and navigation systems, and the Aquila RPV recovery system. O.C.

A83-43701
DEVELOPMENT OF LOW COST RPVS UNDER INDIAN CONDITIONS
 B. K. PARIDA and B. C. BASU (Indian Institute of Technology, Kharagpur, India) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 4.1-4.4. Research supported by the Aeronautics Research and Development Board. refs

Two low cost RPV designs, of which one can be recovered after mission completion while the other cannot, are compared with a view toward such factors as mission duration and survivability, taking into account project break-even cost as a measure of effectiveness. The break-even cost strongly depends on assumed survivability, probability of successful recovery, and mission profiles, as well as on recovery system cost. Plausible analytic solutions to the problem posed indicate that, during a nine-day battle, 700-800 expendable RPVs will be lost, by comparison with 500-900 recoverable ones. The greater spread in the number of recoverable systems lost is due to the effects of greater mission overlaps and transit times for their case. It is also found, however, that the recoverable RPV is under no circumstances more effective than the expendable design. O.C.

A83-43702
A ROCKET-BOOSTED SEA LAUNCHED TARGET SYSTEM
 C. G. COFFEY and A. B. MARKOV (Defence Research Establishment Suffield, Ralston, Alberta, Canada) IN: Remotely piloted vehicles, International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 7.1-7.16.

The ROCKET BOOSTED Target (ROBOT) system, which employs either the CRV7/BATS or ROBOT-9 multistaged vehicles based on the CRV7 rocket motor, has been designed for launch at sea in sea states up to five. ROBOT includes a firing console that permits sea launches from nonstabilized platforms as well as a radar augmentation nosecone, for a realistic target cross section. Attention is presently given to the system's development history, and performance characteristics obtained in recent sea trials where Sea Sparrow anti-aircraft missiles were fired at the ROBOT targets. O.C.

A83-43703
A LOW SIGNATURE RPV
 M. C. PUTTOCK (Thorn EMI Electronics, Hayes, Middx., England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 8.1-8.5. Research supported by the Ministry of Defence (Procurement Executive).

The internal combustion engines with which RPVs are conventionally powered decrease system survivability in that they generate IR (thermal emission) signatures, as well as acoustic

signatures, which betray their position Airbreathing engines such as these, moreover, impose an altitude restriction on the flight of RPVs. Attention is therefore given here to RPV designs which employ a battery pack and electrical motor for propulsion The propulsion system that has been developed for RPV use generates 250 Watts of shaft horsepower for 30 min, despite weighing only 2 kg, and comprises the battery, a motor/gearbox unit, an electronic throttle, and a propeller O.C.

A83-43704

AN/USD-502 (CL 289) RECONNAISSANCE DRONE SYSTEM

F SEIDEL (Dornier GmbH, Friedrichshafen, West Germany) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings . Bristol, University of Bristol, 1982, p 9 1-9 8

The CL 289 airborne reconnaissance drone for army use in the Central European theater of operations has been designed to provide day and night sensor data, and includes a real-time data transmission capability. By using a dead reckoning navigation system, the CL 289 obviates guidance signals from the monitoring ground station This, together with its small size and high subsonic speed, has been shown by studies of the effects of both antiaircraft guns and low level surface-to-air missiles to maximize survivability A fast reaction time is achieved by means of simple launch procedures and automatic checkout equipment The sensors employed are an optical camera for day operations and an IR line scanner for both day and night. The latter is also equipped with a video data transmitter Attention is given to CL 289 support vehicles. O C

A83-43705

THE SKYEYE R-4E SURVEILLANCE SYSTEM

G R SEEMANN, G L HARRIS, H. E. KRACHMAN, and C K LAIR (Developmental Sciences, Inc., City of Industry, CA) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings Bristol, University of Bristol, 1982, p 10.1-10.6

The R-4E airborne reconnaissance RPV has been developed to furnish effective military and/or civilian small object surveillance in real time by means of low altitude, low speed operation The R-4E is equipped with a high resolution EYEBALL video system for real time data gathering, as well as a hard copy reconnaissance camera which provides overlapped horizon-to-horizon 35 mm photographs. The vehicle is of rugged advanced composite construction, able to withstand + or - 6 g's of vertical acceleration due to airloads, + or - 10 g's vertical acceleration on either glide slope or parachute landing, and + 10 g's of axial acceleration during launch. The R-4E is powered by a 30-hp two-cylinder two-stroke engine, and employs a guidance system which allows the craft to be operated in rate, attitude, automatic, or manual modes O C

A83-43706

CANADAIR ROTARY WING R.P.V. TECHNOLOGY DEVELOPMENT. II

A S. CLARK (Canadair, Ltd., Montreal, Canada) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings . Bristol, University of Bristol, 1982, p 11 1-11.17.

The CL-227 rotary wing RPV system was designed to furnish real time surveillance and target acquisition at up to 50 km from the foremost line of troop deployment. The development of the system has reached a second phase, in which the control system of the first-phase vehicle has been applied to a slightly larger vehicle employing a small gas turbine engine in place of the original Wankel rotary, together with an RF data link and real time sensor system Also developed have been a mobile ground launch and recovery system, and a ground control station that is carried by a standard 2.5-ton truck The RPV's sensor system incorporates a daylight vidicon camera and zoom lens The video bandwidth sensor data is transmitted to ground control by means of a dedicated 2.3 GHz FM transmitter. O.C

A83-43707

ASAT - THE U.K.'S NEW TURBO JET R.P.V.

P W SYMS and P S. TURNER (Flight Refuelling, Ltd., Wimborne, Dorset, England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings . Bristol, University of Bristol, 1982, p 12 1-12 7.

The ASAT target drone for surface-to-air missile practice employs a turbojet powerplant, yet considerably reduces overall system costs by obviating the customary JATO-assisted launch procedure Launch is instead accomplished through the RPV's acceleration, under its own power, around a 115 m-diameter circular runway while mounted atop a trolley The ASAT RSV, moreover, has no communications downlink with its ground controller, relying instead on existing radar tracking installations. Because ASAT is autostabilized at all times, only low operator skills are required. ASAT is easily assembled from die cast and sheet metal components on an assembly jig. Attention is given to actuators, avionics, fuel and other ASAT subsystems O.C

A83-43710

THE AERODYNAMICS OF SMALL RPV'S

P. SWAN (British Aerospace PLC, Aerodynamics and Performance Dept., Bristol, England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings Bristol, University of Bristol, 1982, p 17 1-17.14. refs

Attention is given to aerodynamic configuration design trends in mini-RPV systems, of which the most prominent may be characterized as the desire to achieve the highest possible wing loads in order to produce the smallest vehicle, thereby reducing logistics requirements An additional major consideration in mini-RPV design is the need to mount sensors at the RPV's nose, as far away from exhaust heat and vibration as possible An examination is conducted in light of these factors into such aerodynamic parameters as wing lift capability, stall characteristics, pitching moments, lift curve slope, zero lift incidence, and limit of linearity in lift with incidence. While it is not likely that RPV configurations flown to date have reached optimum solutions for their tasks, true optimization cannot be carried out without a substantially improved data base O.C

A83-43715

LAUNCH AND RECOVERY TECHNIQUES FOR RPVS

H J SEDGWICK and T F HAYDON (Royal Aircraft Establishment, Farnborough, Hants., England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings Bristol, University of Bristol, 1982, p 29 1-29 9

A discussion is conducted with respect to the relative advantages of RPV launch and recovery methods which have been investigated by the Royal Aircraft Establishment at Farnborough to date Launch methods have included those employing spring energy storage materials, pneumatic devices, rockets, falling weights, self-powered takeoff, and launch from moving vehicles Recovery methods have involved conventional landing, parachutes, skids, and air cushions. A distinction is drawn between launch and recovery systems suitable for RPVs of up to 20 kg, and those applicable to larger vehicles, of up to 65 kg, which carry multiple payloads. Attention is given to those methods which in addition to being efficient and reliable are inexpensive and simple Where possible, off-the-shelf equipment has been modified to suit a particular RPV configuration. O C

A83-43716

EXTENDED USES OF THE AQUILA RPV SYSTEM

T. D. GOSSETT (U.S. Army, Research and Technology Laboratories, Moffett Field, CA) and F A. VELLIGAN (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers . Bristol, University of Bristol, 1982, p 6.1-6 11.

The Aquila RPV System Technology Demonstrator Program, initiated in 1974, had provided sufficient performance, operations,

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and training characteristics data at the time of its conclusion in 1978 for the U.S. Army to begin the Aquila Full Scale Development (FSD) program. Attention is presently given to the growth capabilities built into the Aquila FSD system, and to the range of Army operations applications for which the Aquila RPV is suitable or essential. The Aquila RPV system encompasses, in addition to the air vehicle, a variety of primary and auxiliary mission payloads, a launcher/recovery subsystem, and a ground control station. The mission scenarios considered include the use of TV and FLIR sensors to acquire artillery targets and assess their damage, as well as to provide attack helicopter support, monitor weather, and accomplish intelligence and EW missions O.C.

A83-43717

SCOUT - A REAL TIME INTELLIGENCE AND SURVEILLANCE SYSTEM

I. RAPAPORT (Israel Aircraft Industries, Ltd., Tel Aviv, Israel) IN: Remotely piloted vehicles, International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 13.1-13.4.

The Scout Mini-RPV system must provide real-time battlefield intelligence, and was designed to satisfy ambitious requirements for reliability, availability and maintainability which entailed the special development of most hardware and all software employed. The resulting development costs of \$30-50 million are comparable to those of other medium-size military systems. The price of \$150,000-300,000 for a Scout electronic package that includes a stabilized optical device is justified by the reliability levels attained, which have been demonstrated during the accumulation of hundreds of successful sorties. O.C.

A83-43734

THEORY OF TRANSPORT AIRCRAFT WEIGHT FRACTIONS

D. P. MARSH (Douglas Aircraft Co., Long Beach, CA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 37 p. (SAWE PAPER 1452)

It is pointed out that weight-estimating methods of various types and level of detail are needed to respond properly to requests for weight information throughout the spectrum of advanced design air vehicle development phases. These phases are categorized into four levels. The present investigation is concerned with the Level I weight-estimating methods. Level I corresponds to an 'early conceptual' phase. This phase is referred to as the 'crystal ball phase' of mass properties engineering. Usually, the type of aircraft, speed, range, payload, and technology level are the only design criteria given. Attention is given to the significance of weight fractions, the correlation of weight fractions, the linearity of weight fractions, weight fractions for commercial passenger aircraft, weight fractions for commercial cargo aircraft, weight fractions for military cargo aircraft, and weight fractions for business aircraft. G.R.

A83-43736

GRUMMAN'S FORWARD SWEEP WING FEASIBILITY STUDIES AND X-29A TECHNOLOGY DEMONSTRATOR

J. E. RAHA (Grumman Aerospace Corp., Bethpage, NY) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 14 p. (SAWE PAPER 1454)

During the closing day of WW II the forward swept wing (FSW) configuration was first used by an experimental aircraft, the JU-287. The motivation for that FSW configuration was to provide a solution to the low-speed lateral instability problem encountered on early aft swept designs while retaining the desired sweep. A generation later, the HFB-320 business jet adopted the configuration. Neither of these aircraft had transonic speed capability or severe maneuvering requirements, and hence the aerodynamic benefits and the troublesome structural side effects of FSW were not approached. The aerodynamic advantages related to the drag reduction during transonic maneuver have led an U.S. aerospace company to propose the FSW configuration for a high performance aircraft. Developments related to this proposal are discussed. Attention is given to details concerning the aerodynamic benefits

of FWS, structural divergence as a FSW difficulty, aspects of performance and configuration integration, and the X-29A technology demonstration. G.R.

A83-43740

OPTIMIZING TAIL SIZE AND WING LOCATION WITHIN LOADABILITY CONSTRAINTS

W. B. TUTOR, D. R. BUSCH, and D. P. MARSH (Douglas Aircraft Co., Long Beach, CA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 21 p. (SAWE PAPER 1466)

The size of the horizontal tail area dictates the center of gravity range, and the wing location determines the position of the payload envelope within this range. The problem of determining center of gravity limits is discussed, with special emphasis given to selecting the optimum wing location and tail size for new or derivative aircraft in such a way as to ensure safe and economical operation while maintaining the required loadability characteristics. The methods discussed make use of functional/geographical mass distribution fractions, center-of-gravity factors, loading limits from 'scissor plots', and computer generated loading diagrams. A procedure to balance an aircraft is described; this includes an outline of the necessary data base information required to make the calculations and a definition of the tools required to actually perform a balance analysis. The technique makes it possible for an engineer to find optimum solutions quite rapidly by having computers perform the repetitive calculations. Attention is also given to the interaction between the various parameters involved in the analysis, showing that a change in any one of the parametric values has a ripple effect on all the other parameters, this makes a direct, one-pass approach to the solution virtually impossible. C.R.

A83-43741

AN INTRODUCTION TO THE BOEING 767-200 AND THE 767 WEIGHT CONTROL PROGRAM

J. GRIFFITHS (Boeing Co., Seattle, WA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 30 p. (SAWE PAPER 1467)

The 767-200 is a medium range, twin engine, commercial transport aircraft designed to carry 211 passengers at ranges up to 2,845 nautical miles with substantially better fuel efficiency than previous generation aircraft. Alternate interior arrangements provide seating capacities for up to 290 passengers. The most significant weight efficient design feature is related to the extensive use of new materials. A total weight reduction of more than 1,900 lb. relative to previous generation aircraft was obtained with the aid of advanced aluminum alloys, Kevlar, graphite-epoxy, and hybrid material applications. The 767 Weight Control Plan is centered around a 'design package team' concept to establish accurate weight estimates early in the Program and to set target weights consistent with overall aircraft weight guarantees. G.R.

A83-43743

WEIGHT REDUCTION FOR FUEL ECONOMY

N. J. CARRAWAY (Lockheed-California Co., Burbank, CA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 13 p. (SAWE PAPER 1469)

The dramatic increases in the average cost of jet fuel during the time from 1967 to 1981 have made fuel cost a critical factor in the determination of the direct operating cost (DOC) of an aircraft. A reduction in fuel consumption as a result of efforts to decrease the operating empty weight of the aircraft will, therefore, lead to a significant reduction of the DOC. Suitable approaches for achieving such a reduction in the aircraft weight are considered. Attention is given to the incorporation of new generation light weight passenger seats, new digital avionics equipment, a use of assemblies made from composite material when replacing damaged or worn parts, and the removal of parts no longer required. It is shown that fuel can also be saved by making appropriate changes with respect to the center of gravity. G.R.

A83-43747

A CRITICAL LOOK AT THE DEVELOPMENT AND APPLICATION OF AIRFRAME COST MODELS

M. N. BELTRAMO (Beltramo and Associates, Culver City, CA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 12 p.
(SAWE PAPER 1478)

The models in current use for estimating the production costs of airframes are examined. It is found that models often fail to achieve their objectives because developers limit themselves to using inadequate empirical data and quantitative methods. What is more, users accept rigid models and are hesitant in changing the values of independent variables, cost factors, and coefficients to conform with their experience or expectations. It is stressed that developers should provide information that will enable users to accept, reject, or modify the model in accordance with their requirements. Users should ensure that cost models are appropriate for the purpose for which they are applied by carefully reviewing critical assumptions and the data they are based on. Cost models based exclusively on empirical data are considered inadequate for estimating the costs of advanced technologies. It is pointed out that rules of thumb and general information, when applied judiciously, may augment empirical data. Since experience within a given firm and among similar firms varies widely, ranges of factors and variables must be considered and applied in developing and using cost models. C.R.

A83-43751

ADVANCED MATERIAL APPLICATION ON THE EUROPEAN WIDE BODY TRANSPORT AIRCRAFT AIRBUS

W. D. WISSEL (Airbus Industrie, Toulouse, France) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 38 p. refs
(SAWE PAPER 1484)

The results of research and development efforts aimed at reducing the weight of the Airbus A300 transport aircraft through the use of advanced composite materials are reviewed. An overall weight saving of 397 kg has been achieved by using structural elements of composites reinforced with aramid and carbon fibers as well as glass/aramid and carbon/aramid hybrid composites. The components of the wing contribute 135 kg, the pylon/nacelle and fuselage components 169 kg, and fin parts 93 kg to the overall weight saving per aircraft. The fuel savings due to the weight reduction vary from 8,600 to 19,400 U.S. gallons depending on the number of flight hours per year and the cruise altitude. Candidate components for further weight reduction are examined. V.L.

A83-43759

V/STOL;STOL;CTOL COMPARISONS

R. T. PRIESTLEY and A. R. YACKLE (Lockheed-California Co., Burbank, CA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 10 p. refs
(SAWE PAPER 1499)

Multi-mission, CTOL, STOL and V/STOL aircraft concepts were sized for the Navy ASW/ASUW missions and comparatively evaluated. Initially, technology levels in the areas of lift, control systems, propulsion, advanced materials and avionics were established for the early 1990's. The aircraft were compared to determine the impact of multi-mission requirements, operational considerations, chiefly takeoff mode, as well as the technology advancements. Results presented include performance envelopes, weight statements, growth factors, impact of technology on weight reduction and the impact of design constraints. Author

A83-43760

THE IMPACT OF MISSIONS ON THE PRELIMINARY DESIGN OF AN ABC ROTOR

G. DE SIMONE, R. S. BLAUCH, and R. A. FISHER (United Technologies Corp., Sikorsky Aircraft, Stratford, CT) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 19 p. refs
(SAWE PAPER 1501)

Recent studies have shown the suitability of the ABC rotor for a wide range of applications. An important consideration regarding all applications is fuel efficiency. The present investigation has the objective to study two of these applications, and examine the impact of the design mission requirements on the preliminary design of the separate rotor systems. An advanced rotor is derived for a cruise design point and a hover design point. Design trends using the two rotor data bases are generated for a troop assault mission (high cruise speed requirement) and for an observation mission (high hover time required). Attention is given to the effect of mission requirements on the selection of critical rotor design parameters of airfoil, twist, taper, radius, chord, and tip speed. G.R.

N83-30361# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

GROUND/FLIGHT CORRELATION ON THE ALPHA-JET EXPERIMENTAL AIRCRAFT WITH A TRANSONIC WING: A COMPARISON BETWEEN WIND TUNNEL AND FLIGHT RESULTS FOR AERODYNAMIC PERFORMANCE

D. JACOB, D. WELTE, and H. WONNENBERG /in AGARD Ground/Flight Test Tech. and Correlation 14 p. Feb. 1983 refs

Avail. NTIS HC A23/MF A01

Wind tunnel and flight results obtained in an experimental program with a transonic wing (TST) on an Alpha-Jet as test vehicle are compared. The comparison is concentrated on lift, drag and buffet data. In addition to the analysis of round and flight data for the TST flight data for the transonic wing and the standard wing are briefly compared. Author

N83-30362# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

GROUND/FLIGHT CORRELATION ON THE ALPHA-JET EXPERIMENTAL AIRCRAFT WITH A TRANSONIC WING: A COMPARISON OF THE WING PRESSURE DISTRIBUTION AND LOCAL WAKE SURVEY FROM ANALYTICAL, WIND TUNNEL AND FLIGHT RESULTS

H. BUERS (Dornier G.m.b.H.), V. SCHMITT, and J. LERAT /in AGARD Ground/Flight Test Tech. and Correlation 20 p. Feb. 1983 refs

Avail. NTIS HC A23/MF A01

Pressure Distributions at four sections of a transonic wing on a combat aircraft have been measured in different wind tunnels and in flight. The results are compared with each other and with theoretical data. In addition, wind tunnel and flight test wake results obtained from a rotating pitot-tube are presented. Author

N83-30364# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

EXPERIMENTAL INVESTIGATIONS OF TRANSPORT AIRCRAFT LOW SPEED ENGINE INTERFERENCE EFFECTS AND FLIGHT TEST CORRELATION

B. EWALD and W. BURGSMUELLER /in AGARD Ground/Flight Test Tech. and Correlation 15 p. Feb. 1983 refs

Avail. NTIS HC A23/MF A01

Engine airframe interference effects for wing mounted engine in transport aircraft development and flight testing were examined. The tendency to reduced engine numbers results in a large effect of the one engine out second segment climb on overall aircraft economy. Large development efforts are worthwhile to realize even small drag reductions in this condition. The most perfect engine simulator available, the turbine powered simulator (TPS), was used in the high speed regime only. The concept of low speed TPS testing was developed. The TPS is proven to be a reliable and valuable experimental tool also in low speed range, provided that

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sophisticated data acquisition and evaluation techniques are used for optimum accuracy and repeatability. Operating equipment and test methods are improved. Results and experience are described.
E.A.K.

N83-30365# Canadair Ltd., Montreal (Quebec).

COMPARISON OF PREDICTION, WIND TUNNEL AND FLIGHT TEST DATA FOR THE CANADAIIR CHALLENGER TURBOFAN AIRCRAFT

F MAVRIPLIS /in AGARD Ground/Flight Test Tech and Correlation 14 p Feb 1983 refs
Avail: NTIS HC A23/MF A01

Theoretical aerodynamic methods, wind tunnel test and flight test for the Challenger aircraft which features an advanced supercritical wing, a wide body and large aft mounted nacelles were presented. These results represent one of first applications of Jameson's isolated wing full potential flow transonic method to advanced wing design for an aircraft which is now in service. The techniques used to obtain wind tunnel force and pressure distribution data at high speed and CLmax data at low speed are described. A flight wing pressure survey which provided data for comparison with wind tunnel test results is described. Correlations of pressure distributions between theory and wind tunnel test indicate the capabilities and limitations of the isolated wing transonic code. Wing pressure and spanwise load distributions from flight test correlate well with corresponding data from wind tunnel tests. Flight test results on CLmax and buffet onset boundary correlate also well with predictions based on wind tunnel data. Reynolds Number and transition fixing for wind tunnel testing of supercritical wings to obtain good correlation with flight test are recommended.
E.A.K.

N83-30366# British Aerospace Aircraft Group, Warton (England)

LESSONS FROM TORNADO AFTERBODY DEVELOPMENT

D. C. LEYLAND /in AGARD Ground/Flight Test Tech and Correlation 15 p Feb. 1983
Avail: NTIS HC A23/MF A01

The wind tunnel model test program for the Tornado aircraft design included the development of a new afterbody test rig, which showed the benefit of measuring airframe axial force separately from nozzle and allowed detailed configuration for minimum drag. Flight tests showed good agreement with drag prediction but handling characteristics under certain conditions were different from predictions derived from full model tests, as a consequence of relatively minor differences in afterbody representation. Flight and model investigations led to satisfactory configuration and to requirements for future model test programs. Flight and model test data were compared by arranging additional afterbody model tests of geometric changes made during the flight program. There was good agreement between results and, conclusions for the requirements for future model and flight testing. The introduction of high frequency response pressure instrumentation is proposed.
E.A.K.

N83-30367# Avions Marcel Dassault, Saint-Cloud (France). Dept Dynamique du Vol

THE HIGH ANGLE OF ATTACK BEHAVIOR OF A COMBAT AIRCRAFT: CORRELATION BETWEEN PREDICTION AND FLIGHT [COMPORTEMENT A GRANDE INCIDENCE D'UN AVION DE COMBAT: CORRELATION ENTRE LES PREVISIONS ET LE VOL]

P. L. MATHE /in AGARD Ground/Flight Test Tech. and Correlation 8 p Feb 1983 In FRENCH
Avail: NTIS HC A23/MF A01

The Mirage 2000 aircraft is equipped with an entirely electronic flight control system. The aircraft is automatically protected from eventual loss of control by a flight control function which assures an automatic limitation of the angle of the aircraft to a value dependent on flight conditions, and by careful adaptation of the command and control functions of the aircraft's axes of roll and loop. This adaptation minimizes the slipping introduced by maneuvers at high angle of attack. The automatic limitation of the

incidence and rigorous control of the transverse axes are keys to the protection of the aircraft against loss of control

Transl. by E.A.K.

N83-30369# Saab-Scania, Linköping (Sweden).

COMPARISON OF FLIGHT AND WIND TUNNEL BUFFETING MEASUREMENTS ON THE SAAB 105 AIRCRAFT

S. H. TEIGE, B. S. A. NILSSON, S. J. BOERSEN (NLR), and A. N. KRAAN (NLR) /in AGARD Ground/Flight Test Tech. and Correlation 10 p Feb. 1983 refs
Avail: NTIS HC A23/MF A01

Buffet tests on a Saab 105 aircraft which were carried out in flight at high speed and wind tunnel measurements on a half model were performed at the same Mach numbers and almost the same Reynolds number are discussed. Buffet levels were derived from wind tunnel accelerometer signals using Jones' method. It is concluded that with careful testing, this method may be used to predict flight buffet loads from wind tunnel measurements
E.A.K.

N83-30371# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

AERODYNAMIC MODEL IDENTIFICATION FROM DYNAMIC FLIGHT TEST DATA AND WIND TUNNEL EXPERIMENTS

J. A. MULDER, J. G. DENHOLLANDER, and H. BINKHORST /in AGARD Ground/Flight Test Tech and Correlation 21 p Feb. 1983 refs
Avail: NTIS HC A23/MF A01

Dynamic flight test techniques may be employed for the measurement of a variety of aircraft performance characteristics as well as for the measurement of stability and control characteristics in the form of for instance classical Stability and Control derivatives. The development of nonlinear aerodynamic models from dynamic flight test data is addressed. Several closely related characteristics of these models are discussed in detail such as goodness of fit to flight test data, the accuracy of model predictions and model complexity. Results are presented of a flight test program with the DHC-2 Beaver experimental aircraft equipped with a high accuracy instrumentation system. Different aerodynamic models are compared with results from windtunnel experiments.
Author

N83-30373# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

CORRELATION ASPECTS OF ANALYTICAL, WIND TUNNEL AND FLIGHT TEST RESULTS FOR A HINGELESS ROTOR HELICOPTER

J. KALETKA and H. J. LANGER /in AGARD Ground/Flight Test Tech and Correlation 16 p Feb. 1983 refs
Avail: NTIS HC A23/MF A01

Two approaches to develop and verify mathematical descriptions of rotorcraft characteristics are discussed: (1) wind tunnel experiments with a model rotor, and (2) parameter identification from flight test data. A rotor test stand with a Mach scaled BO 105 model rotor was used for measurements in two different large wind tunnels. After addressing rotor scaling aspects, emphasis is placed on wind tunnel influences and their corrections to provide the transferability of the results to the full-scale rotor. Specific tests to determine flight mechanical static derivatives are described. BO 105 flight test data were used for the identification of mathematical models describing the dynamic behavior of the helicopter. After an introduction to system identification, the system excitation problem and the verification of results are addressed. Examples showing both identified derivatives and time histories of the helicopter and identified model responses are given. Finally, derivatives extracted from wind tunnel and flight tests are discussed. For comparison theoretically calculated values are also presented.
M.G.

N83-30377# Messerschmitt-Boelkow-Blohm G m b.H., Munich (West Germany). Military Aircraft Div.

GROUND AND FLIGHT TEST TECHNIQUES USED FOR PROOF OF STRUCTURAL INTEGRITY OF THE TORNADO COMBAT AIRCRAFT

K KNAUER and O SENSBURG *In* AGARD Ground/Flight Test Tech and Correlation 48 p Feb 1983 refs
Avail NTIS HC A23/MF A01

A short description of the Tornado program is given. The complex requirements for this all-weather combat aircraft resulted in an optimal concept including features like highly loaded swing wing in combination with a sophisticated high lift system; fly-by-wire and automatic terrain following; supersonic inlet, and two three spool engines with integrated thrust reverser. To accommodate all the mentioned features in a minimum size/weight aircraft, it is necessary to give special attention to the structural aspects. A description of some typical examples for structural certification is presented: load and flutter models, structural component tests, design verification tests, especially for the wing suspension and pivot system, proof and ultimate load testing, and fatigue life assessment. Comparisons of selected predictions with ground and flight test results are presented for the important structural disciplines: stresses and deflections of important components; loads, and aeroelastics. Some examples of bad correlation between theory and test are discussed together with possible explanations. The merits and disadvantages of the most important theoretical methods are highlighted. R.J.F.

N83-30378# British Aerospace Aircraft Group, Warton (England) Aircraft Group.

COMPARISON OF FLIGHT LOADS MEASUREMENTS RESULTS AND PREDICTION FOR TORNADO

J R J. DOVEY and G. MORETTI *In* AGARD Ground/Flight Test Tech. and Correlation 19 p Feb 1983 refs
Avail NTIS HC A23/MF A01

An extensive program of flight loads measurements was made on Tornado MARCA aircraft to contribute to service clearance as required by the American Military specifications. A brief resume is presented of the purpose of flight load measurements, the overall program, the calibration of the load measurement devices, the data reduction facilities, the flying techniques and of the methods used for detailed analysis of the results. Comparisons are made between flight measurements and predictions for several aircraft components for specific maneuvers and for rates of change of load with change of aircraft parameters. The contribution of flight load measurements to the extension of the flight envelope in rapid roll maneuvers is discussed and the usefulness to the final Tornado flight clearance is also assessed. R.J.F.

N83-30401*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.

INTEGRATED APPLICATION OF ACTIVE CONTROLS (IAAC) TECHNOLOGY TO AN ADVANCED SUBSONIC TRANSPORT PROJECT: WING PLANFORM STUDY AND FINAL CONFIGURATION SELECTION Final Report, Jun. 1979 - Oct. 1980

Jun. 1981 382 p refs
(Contract NAS1-15325)
(NASA-CR-165630, NAS 1.26 165630; D6-48676) Avail NTIS HC A17/MF A01 CSCL 01C

The Wing Planform Study and Final Configuration Selection Task of the Integrated Application of Active Controls (IAAC) Technology Project within the Energy Efficient Transport Program is documented. Application of Active Controls Technology (ACT) in combination with increased wing span resulted in significant improvements over the Conventional Baseline Configuration (Baseline) and the Initial ACT Configuration previously established. The configurations use the same levels of technology, takeoff gross weight, and payload as the Baseline. The Final ACT Configuration (Model 768-107) incorporates pitch-augmented stability (which enabled an approximately 10% aft shift in cruise center of gravity and a 44% reduction in horizontal tail size), lateral/directional-augmented stability, an angle-of-attack limiter,

and wing-load alleviation. Flutter-mode control was not beneficial for this configuration. This resulted in an 890 kg (1960 lb) reduction in airplane takeoff gross weight and a 9.8% improvement in cruise lift/drag. At the Baseline mission range (3589 km 1938 nmi), this amounts to 10% block-fuel reduction. Results of this task strongly indicate that the IAAC Project should proceed with the Final ACT evaluation, and begin the required control system development and test. Author

N83-30402*# Boeing Commercial Airplane Co., Seattle, Wash. **NACELLE AERODYNAMIC AND INERTIAL LOADS (NAIL) PROJECT Test Report, Oct. 1979 - Nov. 1980**

May 1981 352 p refs
(Contract NAS1-15325; NAS3-20632)
(NASA-CR-168712, NAS 1.26-168712) Avail NTIS HC A16/MF A01 CSCL 01C

The testing was conducted on the Boeing-owned 747 RA001 test bed airplane during the concurrent 767/JT9D-7R4 engine development program. Following a functional check flight conducted from Boeing Field International (BFI) on 3 October 1980, the airplane and test personnel were ferried to Valley Industrial Park (GSG) near Glasgow, Montana, on 7 October 1980. The combined NAL and 767/JT9D-7R4 test flights were conducted at the Glasgow remote test site, and the airplane was returned to Seattle on 26 October 1980. Author

N83-30403*# Boeing Commercial Airplane Co., Seattle, Wash. **ADVANCED COMPOSITE ELEVATOR FOR BOEING 727 AIRCRAFT Quarterly Technical Progress Report, 23 Nov. 1978 - 22 Feb. 1979**

22 Feb. 1979 30 p
(Contract NAS1-14952)
(NASA-CR-172910, NAS 1.26-172910, QTPR-7) Avail NTIS HC A03/MF A01 CSCL 01C

Detail design activities are reported for a program to develop an advanced composites elevator for the Boeing 727 commercial transport. Design activities include discussion of the full scale ground test and flight test activities, the ancillary test programs, sustaining efforts, weight status, and the production status. Prior to flight testing of the advanced composites elevator, ground, flight flutter, and stability and control test plans were reviewed and approved by the FAA. Both the ground test and the flight test were conducted according to the approved plan, and were witnessed by the FAA. Three and one half shipsets have now been fabricated without any significant difficulty being encountered. Two elevator system shipsets were weighed, and results validated the 26% predicted weight reduction. The program is on schedule. Author

N83-30404*# Lockheed-California Co., Burbank **ADVANCED MANUFACTURING DEVELOPMENT OF A COMPOSITE EMPENNAGE COMPONENT FOR L-1011 AIRCRAFT. PHASE 2: DESIGN AND ANALYSIS Final Report**

A C. JACKSON, J. F. CROCKER, J. C. EKVALL, R. R. EUDAILY, B. MOSESAN, R. R. VANCELEAVE, and J. VANHAMERSVELD
Apr 1981 215 p refs
(Contract NAS1-14000)
(NASA-CR-165634, NAS 1.26 165634, LR-29723) Avail NTIS HC A10/MF A01 CSCL 01C

The composite fin design consists of two one-piece cocured covers, two one-piece cocured spars and eleven ribs. The lower ribs are truss ribs with graphite/epoxy caps and aluminum truss members. The upper three ribs are a sandwich design with graphite/epoxy face sheets and a syntactic epoxy core. The design achieves a 27% weight saving compared to the metal box. The fastener count has been reduced from over 40,000 to less than 7000. The structural integrity of the composite fin was verified by analysis and test. The static, fail-safe and flutter analyses were completed. An extensive test program has established the material behavior under a range of conditions and critical subcomponents were tested to verify the structural concepts. Author

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N83-30405*# Lockheed-California Co., Burbank
ADVANCED COMPOSITEAILERON FOR L-1011 TRANSPORT AIRCRAFT: GROUND TESTS AND FLIGHT EVALUATION Final Report, Jan. - Dec. 1980

C. F. GRIFFIN Feb. 1981 41 p
(Contract NAS1-15069)

(NASA-CR-165664, NAS 1.26:165664; LR-29676) Avail: NTIS HC A03/MF A01 CSCL 01C

A composite aileron and a metal aileron were subjected to a series of comparative stiffness and vibration tests. These tests showed that the stiffness and vibration characteristics of the composite aileron are similar to the metal aileron. The first composite ground test article was statically tested to failure which occurred at 139 percent of design ultimate load. The second composite ground test article was tested to verify damage tolerance and fail-safe characteristics. Visible damage was inflicted to the aileron and the aileron was subjected to one lifetime of spectrum fatigue loading. After conducting limit load tests on the aileron, major damage was inflicted to the cover and the aileron was loaded to failure which occurred at 130 percent of design ultimate load. A shipset of composite ailerons were installed on Lockheed's L-1011 flight test aircraft and flown. The composite aileron was flutter-free throughout the flight envelope. Author

N83-30406*# Lockheed-California Co., Burbank.
ADVANCED COMPOSITEAILERON FOR L-1011 TRANSPORT AIRCRAFT: DESIGN AND ANALYSIS Final Report, Apr. 1977 - Oct. 1980

C. F. GRIFFIN, L. D. FOGG, and E. G. DUNNING Apr. 1981 171 p refs

(Contract NAS1-15069)

(NASA-CR-165635, NAS 1.26:165635; LR-29635) Avail: NTIS HC A08/MF A01 CSCL 01C

Detail design of the composite aileron has been completed. The aileron design is a multi-rib configuration with single piece upper and lower covers mechanically fastened to the substructure. Covers, front, spar and ribs are fabricated with graphite/epoxy tape or fabric composite material. The design has a weight savings of 23 percent compared to the aluminum aileron. The composite aileron has 50 percent fewer fasteners and parts than the metal aileron and is predicted to be cost competitive. Structural integrity of the composite aileron was verified by structural analysis and an extensive test program. Static, failsafe, and vibration analyses have been conducted on the composite aileron using finite element models and specialized computer programs for composite material laminates. The fundamental behavior of the composite materials used in the aileron was determined by coupon tests for a variety of environmental conditions. Critical details of the design were interrogated by static and fatigue tests on full-scale subcomponents and subassemblies of the aileron. Author

N83-30407*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering
LONGITUDINAL FLYING QUALITIES CRITERIA FOR SINGLE-PILOT INSTRUMENT FLIGHT OPERATIONS Final Report, 5 Apr. 1979 - 30 Nov. 1982

R. F. STENGEL and A. BAR-GILL Jul 1983 249 p refs
(Contract NAS1-15764)

(NASA-CR-166084, NAS 126:166084; MAE-1576-T) Avail: NTIS HC A11/MF A01 CSCL 01C

Modern estimation and control theory, flight testing, and statistical analysis were used to deduce flying qualities criteria for General Aviation Single Pilot Instrument Flight Rule (SPIFR) operations. The principal concern is that unsatisfactory aircraft dynamic response combined with high navigation/communication workload can produce problems of safety and efficiency. To alleviate these problems. The relative importance of these factors must be determined. This objective was achieved by flying SPIFR tasks with different aircraft dynamic configurations and assessing the effects of such variations under these conditions. The experimental results yielded quantitative indicators of pilot's performance and workload, and for each of them, multivariate

regression was applied to evaluate several candidate flying qualities criteria S.L.

N83-30408# Air Force Flight Test Center, Edwards AFB, Calif.
ENVIRONMENTAL CONTROL SUBSYSTEMS FLIGHT TEST HANDBOOK Final Report

K. J. LUSH Dec. 1982 159 p refs

(AD-A126872, AFFTC-TIH-82-2) Avail: NTIS HC A08/MF A01 CSCL 13A

This handbook provides AFFTC engineers with guidelines for the testing of environmental control subsystems. Future technological advances, characteristics of individual aircraft or programs may necessitate other methods being used in some cases. A background is provided on environmental control subsystems and the requirements to which they are designed. Details are provided of individual tests, test support requirements and evaluations criteria and suggestions made for presentation of results. GRA

N83-30409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRAUMATIC OCCLUSION OF THE VERTEBRAL ARTERY CAUSED BY NECK ROTATION

T. GOYA, K. KINOSHITA, and K. MIHARA 17 Feb. 1983 14 p refs Transl into ENGLISH from Noshinkei Gaika (Japan), v. 7, no. 12, 1979 p 1197-1202

(AD-A126922; FTD-ID(RS)T-1723-82) Avail: NTIS HC A02/MF A01 CSCL 06E

Vertebral artery occlusion due to the sudden rotation of the neck is discussed. A case history is given. The importance of vertebral angiography is discussed R J F

N83-30410# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

LIMITED ARTIFICIAL AND NATURAL ICING TEST OF THE OV-ID (RE-EVALUATION) Final Report, 1 Feb. - 3 May 1982

R. B. CARPENTER, R. N. WARD, and R. D. ROBBINS Jun. 1982 83 p refs

(AD-A127191; USAAEFA-81-21) Avail: NTIS HC A05/MF A01 CSCL 08L

The USAAEFA conducted an icing evaluation of the engine inlets of an OV-ID aircraft. The test included artificial icing flights in St. Paul, Minnesota and natural icing flights in Salem, Oregon. A total of 13 test flights, 8 artificial tests and 5 natural tests, totalling 22.8 hours were performed. Total cloud immersion time was 4.2 hours for artificial icing and 6.5 for natural icing. A range of temperatures, liquid water contents and droplet sizes were experienced. The engine inlet ice protection system was modified three times. The modifications included increased electrical power available, increased duty times of heating elements, and addition of insulation in the cowl. The No. 2 engine final configuration cowl produced the most favorable ice accretion characteristics. However, in all cases, ice formed on the propeller blades, propeller spinners and propeller spinner afterbody. In artificial icing tests, ice was found inside the engine inlet. Aircraft performance was significantly degraded apparently due to ice accretion on the propeller blades. Two deficiencies were identified: the inability of the windshield anti-ice system to clear the windshield of ice; and, significant quantities of ice forming on the propeller spinner afterbody. GRA

N83-30716# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

DETERMINATION OF THE DYNAMIC ENVIRONMENT OF THE F/FB-111 TAIL POD ASSEMBLY

J. CHINN and P. BOLDS In Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 52. Part 3 p 115-129 May 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 01C

A comprehensive dynamic study was conducted on the F/FB-111 aircraft by Air Force Wright Aeronautical Laboratories. The vibration and acoustic data were needed to define the environment of the tail pod assembly in order to mount sensitive

electronic equipments within. These data were compared with predicted F-111 Tail Warning Systems Specification ASD/ENAM-78-1 and Military Standard Environment Test Methods, 810-C. From the analysis of the data presented in this study, vibration data in the 300 to 500 Hz range exceeded the specification and does not allow a sufficient cushion for endurance testing for many of the transient conditions. Author

N83-30717# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

AN ASSESSMENT OF THE A-10'S CAPABILITY TO OPERATE ON ROUGH SURFACES

T. G. GERARDI and D. L. MORRIS /in Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 52 Part 3 p 131-143 May 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 01C

A study was conducted on the A-10's capability to operate on rough surfaces; specifically rapidly repaired bomb damage runways and taxiways. Emphasis was placed on a European combat configured takeoff gross weight of 40,755 pounds and a typical landing configuration weight of 30,300 pounds. Five types of bomb damage repairs were considered, specifically A through E category repairs. Results of the study indicate that the A-10 tends to respond to rough surfaces in its rigid body pitch mode thus making the nose landing gear (NLG) the critical component. An analytical study shows that by increasing the NLG strut precharge pressure from 179 psi to 250 psi, peak NLG loads are reduced by 20%. In addition, application of aft stick will unload the NLG and reduce NLG loads. Author

N83-30769# Imperial Coll. of Science and Technology, London (England).

VIBRATION ANALYSIS OF A HELICOPTER PLUS AN EXTERNALLY-ATTACHED STRUCTURE

D. J. EWINS, J. M. M. SILVA, and G. MALECI /in Shock and Vibration Information Center The Shock and Vibration Bull., no. 50, part 2 p 155-172 Sep 1980 refs 4 Vol

Avail: NTIS HC A12/MF A01 CSCL 01C

A vibration analysis was made of a complex structure comprising a helicopter airframe, external carrier platform and a store, in order to construct a mathematical model for use in a design optimization exercise. The model formed was based on impedance coupling of component substructures, using experimentally derived modal data for the airframe and store, and a finite element theoretical model of the carrier. Predictions for the complete assembly agreed well with data measured on the actual structure over much of the frequency range, although the accuracy was reduced at higher frequencies. Further investigation indicated that this effect was probably due to approximations made in the coupling conditions, rather than to limitations in the models of the substructures. The exercise demonstrates the usefulness of this type of analysis for complex engineering structures and also highlights some problems which may be encountered in applying theoretically straightforward techniques to practical cases. Author

N83-30790# Lockheed Missiles and Space Co., Sunnyvale, Calif.

MODIFICATION OF FLIGHT VEHICLE VIBRATION MODES TO ACCOUNT FOR DESIGN CHANGES

C. W. COALE and M. R. WHITE /in Shock and Vibration Bulletin, no. 50, part 3 p 163-178 Sep. 1980

Avail: NTIS HC A10/MF A01 CSCL 01C

A method of incorporating spacecraft structural changes by modifying existing flight vehicle modes is presented. The method is applicable for arbitrary changes of mass, stiffness, and structural configuration in a limited area of the vehicle. Author

N83-30796*# Lockheed-California Co., Burbank.

SONIC FATIGUE TESTING OF THE NASA L-1011 COMPOSITE AILERON

J. SOOVERE /in Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 50., Part 4 p 13-24 Sep. 1980 refs (Contract NAS1-15069)

Avail: NTIS HC A11/MF A01 CSCL 01C

The sonic fatigue test program to verify the design of the composite inboard aileron for the L-1011 airplane jet noise environment is described. The composite aileron is fabricated from composite minisandwich covers which are attached to graphite/epoxy front spar and ribs, and to an aluminum rear spar with fasteners. Coupon testing, with large electromagnetic shakers, is used to develop random S/N (stress vs. number of cycles) data for specific components in the design. Coupon failure modes are presented and discussed. The center section of the composite aileron is mounted by its hinge fittings to a test frame and sonic fatigue tested in an acoustic progressive wave tunnel. The testing involves modal studies to establish mode shapes, modal frequencies and damping, and a panel response nonlinearity test culminating in the accelerated sonic fatigue proof test. Author

N83-31189 Technische Univ., Hamburg (West Germany)

DETECTION AND RANGING OF ELECTRIC CHARGED HELICOPTERS

H. TRINKS and J. L. TERHASEBORG (Hochschule der Bundeswehr, Hamburg) /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 8 p Jun 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N. J. \$25.00

Helicopters are electrically charged during their flight. The electric charge generates an electric field in the helicopters' vicinity which can be measured. It is found that by such electric field measurements the detection and localization of flying helicopters is possible. Systematic investigations were performed for different types of helicopters flying over ground based electric field sensors. Supplementary electric field sensors were telemetric guided in the vicinity of hovering helicopters. The experimental results were compared with theoretical computations about electric field distributions of electric charged helicopters hovering near trees and buildings. E.A.K.

N83-31594 British Aerospace Aircraft Group, Kingston-upon-Thames (England).

AERODYNAMIC EJECTORS IN THE UK

C. L. BORE 15 Oct 1981 7 p refs

(BAE-KRS-N-GEN-243) Avail: Issuing Activity

The applications of ejectors to wind tunnel drives, model engine simulators and reaction control in vertical takeoff and short takeoff aircraft are surveyed. The design of ejector systems for the P1127 Harrier and the use of ejectors to simulate multiple four lift units and jet engines in wind tunnel models are discussed. Theory developments covering conventional mixing ejectors and rotary ejectors are outlined. It is suggested that rotary augmentors could be applied in rear end reaction controls and that they could also be useful as engine power simulators for model aircraft. Author (ESA)

N83-31595*# Douglas Aircraft Co., Inc., Long Beach, Calif.

ADVANCED COMPOSITE VERTICAL STABILIZER FOR DC-10 TRANSPORT AIRCRAFT Quarterly Technical Progress Report, 25 Sep. - 31 Dec. 1978

C. O. STEPHENS 22 Jan 1979 200 p refs

(Contract NAS1-14869)

(NASA-CR-172780; NAS 1 26 172780; ACEE-03-PR-9642,

QTPR-7) Avail: NTIS HC A09/MF A01 CSCL 01C

Structural design, tooling, fabrication, and test activities are reported for a program to develop an advanced composite vertical stabilizer (CVS) for the DC 10 Commercial Transport Aircraft. Structural design details are described and the status of structural and weight analyses are reported. A structural weight reduction of 21.7% is currently predicted. Test results are discussed for sine

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wave stiffened shear webs containing representative of the CVS spar webs and for lightning current transfer and tests on a panel representative of the CVS skins

Author

N83-31596*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

SERVICE LIFE EVALUATION OF RIGID EXPLOSIVE TRANSFER LINES

L. J. BEMENT, E. G. KAYSER (NSWC, Silver Spring, Md.), and M. L. SCHIMMEL (McDonnell Aircraft Co., St Louis) Aug. 1983 56 p refs Original contains color illustrations (NASA-TP-2143; L-15558; NAS 1.60:2143) Avail NTIS HC A04/MF A01 CSCL 01C

This paper describes a joint Army/NASA-sponsored research program on the service life evaluation of rigid explosive transfer lines. These transfer lines are used to initiate emergency crew escape functions on a wide variety of military and NASA aircraft. The purpose of this program was to determine quantitatively the effects of service, age, and degradation on rigid explosive transfer lines to allow responsible, conservative, service life determination. More than 800 transfer lines were removed from the U.S. Army AH-1G and AH-1S, the U.S. Air Force B-1 and F-111, and the U.S. Navy F-14 aircraft for testing. The results indicated that the lines were not adversely affected by age, service, or a repeat of the thermal qualification tests on full-service lines. Extension of the service life of rigid explosive transfer lines should be considered, since considerable cost savings could be realized with no measurable decrease in system reliability.

Author

N83-31597*# Lockheed-Georgia Co., Marietta

NEW CONSIDERATIONS ON SCALE EXTRAPOLATION OF WING PRESSURE DISTRIBUTIONS AFFECTED BY TRANSONIC SHOCK-INDUCED SEPARATIONS

M. M. S. KAHN and J. F. CAHILL Mar 1983 63 p refs (Contract NAS2-10855) (NASA-CR-166426; NAS 1.26 166426; LG83ER0055) Avail. NTIS HC A04/MF A01 CSCL 01C

Use of this analytical parameter, it is shown, highlights the distinction between cases which are dominated by trailing-edge separation, and those for which separation at the shock foot is dominant. Use of the analytical parameter and the distinction noted above greatly improves the correlation of separation data and the extrapolation of wind tunnel data to flight conditions

Author

N83-31598# Naval Postgraduate School, Monterey, Calif Dept. of Aeronautics.

EXPANSION OF THE SCAN ENDGAME PROGRAM FOR AIRCRAFT SURVIVABILITY STUDIES AND DEVELOPMENT OF A SUPPORTING USER'S GUIDE M.S. Thesis

J. P. FOURNY Dec. 1982 151 p refs (AD-A127557) Avail NTIS HC A08/MF A01 CSCL 09B

This study involved a detailed examination of the aircraft survivability analysis program called SCAN, and modification of the pre and post-processing graphics programs that support the program. The aim was the improvement of the originally installed version of SCAN at NPS by incorporating the graphics commands for the new IBM supported terminals, by increasing the speed of the display process, and by simplifying the input data preparation by making it more interactive. In addition, a comprehensive User's Guide was prepared for use by NPS students involved in aircraft survivability/warhead lethality studies.

Author (GRA)

N83-31599# Aeronautical Research Labs., Melbourne (Australia)

COMBAT PERFORMANCE EVALUATION OF FIGHTER AIRCRAFT: A SUITE OF FORTRAN-IV PROGRAMS BASED ON ENERGY MANOEUVRABILITY THEORY

G. W. KIPP Mar. 1982 162 p (AD-A128263; ARL/MECH/ENG-160) Avail NTIS HC A08/MF A01 CSCL 01C

A suite of FORTRAN-IV computer programs is described which may be used to assist in evaluating relative combat aircraft performance, using energy maneuverability theory. The programs

are described in detail using flowcharts, and full operating instructions are given. A selection of outputs illustrates the graphical and printed capabilities of the suite.

GRA

N83-31600# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.

COMPUTER PROGRAM ANALYSIS OF HELICOPTER WEIGHT ESTIMATE RELATIONSHIPS UTILIZING PARAMETRIC EQUATIONS M.S. Thesis

R. T. SCHWAB Jun. 1983 62 p refs (AD-A128590) Avail. NTIS HC A04/MF A01 CSCL 09B

This thesis gives the user of an HP-41CV handheld programmable calculator of the IBM 3033 computer, acceptable results of helicopter system weight estimations during the preliminary design phase. The computer program consists of several subroutines and will compute system weight estimates according to Military Standard 1374A. Three categories of military helicopters can be designed; observation, utility, and cargo. Detailed knowledge of helicopters is not required.

Author (GRA)

N83-31601# Army Aviation Engineering Flight Activity, Edwards AFB, Calif. Directorate for Development and Qualification.

FUEL CONSERVATION EVALUATION OF US ARMY HELICOPTERS. PART 5: AH-1S SLIGHT TESTING Final Report, 31 Jul. - 21 Sep. 1982

L. L. TODD, R. T. SAVAGE, R. L. VINCENT, R. A. WILLIAMS, G. T. DOWNS, and M. K. HERBST Jan 1983 74 p refs (AD-A128532; USAAEFA-81-01-5) Avail. NTIS HC A04/MF A01 CSCL 01C

The United States Army Aviation Engineering Flight Activity conducted level flight performance tests of the AH-1S (Prod) helicopter to provide data to determine the most fuel efficient operating conditions. Hot and cold weather test sites were used to extend the range of the advancing tip Mach number data to supplement existing AH-1S performance data. Preliminary analysis of non-dimensional data identifies the effects of compressibility on performance and shows a power penalty of as much as 6% at a high NR/theta. The power required characteristics determined by these tests can be combined with engine performance to determine the most fuel efficient operating conditions.

GRA

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A83-41532

A HISTORY OF ELECTRONIC FLIGHT INSTRUMENTS - THROUGH TOMORROW

P. G. COOPER (Cooper Avionics, Inc., Montara, CA) Vertiflite (ISSN 0042-4455), vol 29, July-Aug. 1983, p 26-29.

Electronic Flight Instrument Systems (EFIS) are able to graphically integrate data (heretofore displayed on separate mechanical devices) in the form of an easily interpreted picture. Attention is presently given to the development history of EFIS, which began with the introduction of CRTs in the cockpits of U.S. Navy A-6 aircraft in the late 1950s. Directly viewed ('head-down') or optically projected ('head-up') EFIS were developed to compensate for increasing pilot workload and task complexity, and such sophisticated viewing devices as forward looking IR, low level TV and radar have been subsequently integrated with flight and weapon delivery symbology on both head-up and head-down media. More recent developments have capitalized on miniaturization of electronic and optical elements, to allow EFIS mountings on helmets and even eyeglasses. Attention is also given to the prospective development of aural and tactile systems.

O.C

A83-41533

LAMPS MK III ACOUSTIC TARGET TRACKER

J ACTON (IBM Corp., Federal Systems Div., Bethesda, MD) Vertiflite (ISSN 0042-4455), vol. 29, July-Aug. 1983, p 30-33.

The LAMPS MK-III ASW system employs an SH-60B helicopter which, operating under the tactical control of its parent ship, functions as a remote sensor platform for the detection of enemy submarines within the operational range of the parent ship. After discussing the submarine detection problems encountered by this system to date, attention is given to the development of passive tracking algorithms for the automation of tracking methods used to analyze sonobuoy signals. Four such algorithms are employed: a target tracker, an initial target location estimator, a periodic frequency measurement generator for target tracker filtering, and a bearing tracker. A Monte Carlo simulation of typical LAMPS submarine detection scenarios has been conducted in order to identify the performance benefits of the passive tracking algorithms, relative to the existing, least squares tracking algorithm. O C.

A83-41922*# Milco International, Inc., Huntington Beach, Calif
DIGITAL INSTRUMENTATION ANALYSIS AND NAVIGATION
SYSTEM (DIANS) FOR SYSTEM IDENTIFICATION

R K SMYTH, D E SMYTH (Milco International, Inc., Huntington Beach, CA), and L W. TAYLOR, JR (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 12 p
 (Contract NAS1-16561)
 (AIAA PAPER 83-2091)

Hardware, software, and performance features of the Digital Instrumentation and Navigation System (DIANS) designed for NASA research to collect flight data as a strap-down system are detailed. The support software for the system has a cross compiler, a linkage editor, and cross assembler, extended communication capabilities, postflight processing applications, and compilers for PASCAL, FORTRAN, CBASIC and MT. The DIANS microcomputer has a 1 Mbyte RAM module, a fast floating point processor board, a 68000 monoboard computer with 64 RAM, a 128 Kbyte bubble memory card, and a navigation radio. The system also carries a battery for full system operation for over an hour. The support software is also stored on a host mainframe computer, which has a CP/M operating system. Pitch, roll, and heading data are gathered from the on-board system, and communication is possible between the airborne and ground-based computer. M.S.K.

A83-42152

A METHOD FOR ENSURING THE PROPER OPERATION OF
AN OPTICAL INSTRUMENT FOR MEASURING THE
TEMPERATURE OF THE BLADES OF A HIGH-TEMPERATURE
TURBINE [METOD OBESPECHENIIA RABOTOSPOSOBNOSTI
OPTICHESKOGO IZMERITELIA TEMPERATURY LOPATOK
VYSOKOTEMPERATURNOI TURBINY]

A P MERKULOV, V T VOLOV, and V E VILIAKIN Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p 104, 105 In Russian

The use of infrared detectors makes it possible to continuously monitor the temperature of the individual blades of a turbine to within plus or minus 5 K, an accuracy adequate for an automatic control system. However, since such detectors must be installed in the vicinity of the blade ring, they require efficient local cooling. Here, the use of a self-vacuumized vortex tube for stabilizing the temperature of infrared detectors is examined. Experimental data are presented which show that the cooling efficiency of a vortex tube increases with the temperature at the inlet of the tube and with the power input of the cooled rod located inside the tube.

V L

A83-42835#

NEODYMIUM YAG LASER IN AIRBORNE SYSTEMS

J. C. DUNCAN (Ferranti PLC, Cheadle, Ches., England) IN The impact of lasers on avionic systems; Proceedings of the Symposium, London, England, March 23, 1983. London, Royal Aeronautical Society, 1983, 3 p

Requirements for an airborne laser were generated in the UK in the 1960s, when the Royal Air Force decided that mission profiles in the event of war in the Central European theatre would have to be at high speed and at low level. The requirements involved, in particular, in very low level aircraft attacks could best or only be satisfied with the aid of a direct ranging sensor based on the use of a laser. For meeting the required weapon aiming accuracies, a laser was needed with a very small beam divergence and very short pulse length. A complimentary requirement was for a laser target marker. A Laser Ranger and Marked Target Seeker was developed to meet the Royal Air Force requirements. The device consists of a laser head and an electronic unit. The laser includes two porro prisms with their knife edge optically perpendicular to each other, a neodymium doped YAG rod, a polarizer, and a lithium niobate crystal. G.R.

A83-43323

AIRCRAFT NIGHT LIGHTING SYSTEMS

C S PIEROWAY (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr 12-15, 1983 6 p.

(SAE PAPER 830713)

The Air Force has developed several aircraft cockpit lighting techniques that will reduce glare, windscreen reflections, improve visibility and are compatible with Night Vision Goggles. These techniques utilize a combination of microencapsulated Electroluminescent lamps, light control film, light filters, and dimmers to control light placement, wavelength, and intensity. These techniques are applicable to military, commercial, and general aviation aircraft. Author

A83-43708

THE APPLICATION OF GYROSCOPES IN REMOTELY PILOTED VEHICLES

R J CHAPLIN (British Aerospace PLC, Dynamics Group, Stevenage, Herts, England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings Bristol, University of Bristol, 1982, p 15 1-15.10

A discussion is presented concerning RPV gyroscope requirements, with attention to the recently developed two-axis rate gyro and dynamically tuned gyro, as well as a low cost stabilized mirror. Autopilots, heading and altitude reference systems, navigation systems, and payloads all require stabilization. The Dual Axis Rate Transducer (DART) is a two-axis hydrodynamic rate sensor employing the internal reaction of a fluid-filled body rotating at high velocity to provide rate data. The Dynamically Tuned Gyro (DTG) is basically a twin-axis free gyro which is always used in a feedback loop. The directly coupled gyro-stabilized mirror is used in the stabilization of RPV TV and IR surveillance camera lines-of-sight. Design feature schematics and performance figures are provided for the DART, DTG and stabilized mirror. O C.

A83-43712

PYROELECTRIC IR IMAGING SENSORS - THE POTENTIAL FOR COMPACT INEXPENSIVE RPV PAYLOADS

R. WATTON (Royal Signals and Radar Establishment, Malvern, Worcs., England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings Bristol, University of Bristol, 1982, p 21 1-21.13. Research supported by the Ministry of Defence. refs

Attention is given to recent improvements in pyroelectric vidicon technology, as well as prospective advancements in pyroelectric/CCD staring arrays and long linear array hybrids. IR sensor heads predicated on pyroelectric devices do not require a cryogenic package and are relatively inexpensive, making them

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uniquely suitable for RPV missions requiring either expendability or long endurance. Their moderate detectivity, however, implies that a large number of detector elements must be used to obtain an image of acceptable quality. Consideration is given to such factors affecting performance as thermal diffusion, spatial resolution, reticulated targets, target material, minimum resolvable temperatures, and the panning, chopping, and signal processing of RPV pyroelectric vidicon cameras O.C.

A83-43720

A VERSATILE THERMAL IMAGER FOR RPV APPLICATIONS

D. H. ARNOLD and R. D. HOYLE (Thorn Emi Electronics, Ltd., Feltham, Middx., England) IN Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 22 1-22.9.

The design of a small volume, low weight thermal imager for battlefield RPV applications that is based on the use of Class I modules developed under the U.K. Ministry of Defence Thermal Imaging Common Modules program is discussed. The thermal imager employs a telescope, a scanner module, and an indirect view converter. The system as a whole incorporates four Class I modules: the Scanner Module, a Video Module, a Common Services module for interface between the Video Module and operator controls of temperature window, temperature offset, and inversion, and a DC/DC converter O.C.

A83-43721

IMAGING SENSORS FOR AN RPV PAYLOAD

J. W. JACK (Ferranti, Ltd., Electro-Optics Dept., Edinburgh, Scotland) IN Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 23.1-23.7.

This paper will discuss some of the considerations in the choice of a sensor for an RPV mission payload and mention some of the factors which influence the choice of sensor for a particular task. Those factors which limit the performance will be indicated and the main sensor characteristics suggested. These characteristics are then discussed in more detail for four sensor types and some comparative comments made. The constraints which determine the configurations are discussed and two particular configurations are shown which have applicability to RPV payloads. It is pointed out that a careful analysis of the requirement must be carried out to ensure that the optimum choice of payload components is made. Author

N83-30411 Royal Aircraft Establishment, Farnborough (England).

RECOMMENDED COLOURS FOR USE ON AIRBORNE DISPLAYS

J. LAYCOCK 11 Nov. 1982 95 p refs (RAE-TR-82110; RAE-FS(F)-190; BR86911) Avail Issuing Activity

The derivation of color standards is outlined, and the unsuitability of these standards for electronic displays is pointed out. A computational procedure which enables color boundaries to be specified is described. Data derived using the procedure are presented Author (ESA)

N83-30412# National Aeronautics and Space Administration, Washington, D C.

INSTALLATION, VALIDATION AND FLIGHT EVALUATION OF THE FEDERAL AVIATION ADMINISTRATION'S HEAD-UP DISPLAY SYSTEM Final Report

B. C. SCOTT, C. O. MASTERS, J. J. RYAN, and A. T. BRAZER Atlantic City, N.J. FAA Apr. 1983 172 p Prepared in cooperation with FAA, Atlantic City, N.J. (Contract FAA PROJ. 073-320-510)

(NASA-TM-85255; NAS 1 15 85255; DOT/FAA/CT-82/92; DOT/FAA/PM-83/5) Avail: NTIS HC A08/MF A01 CSCL 01D

Selected activities and results associated with the installation, validation, and flight evaluation of Head-Up Display (HUD) research system as installed in a Boeing 727-100 aircraft is documented.

Requisite installation, boresight, and flight validation activities, along with results obtained from a combined flight experience/flight evaluation exercise employing government pilots are presented. Pilot comments addressing HUD system performance, display symbology, control low responses, hardware implementation, and operational modes are addressed. The HUD, a one of a kind flightpath oriented research HUD, was evaluated in both an inertial (INS) referenced mode and an airmass referenced mode. Overwhelmingly, there was a strong preference for the INS referenced HUD mode. S.L.

N83-30413# Boeing Military Airplane Development, Wichita, Kans. Mechanical/Electrical Systems Technology Organization

CALIBRATION OF C-130 LIGHTNING CHARACTERIZATION SENSORS Final Technical Report, 1 Jul. 1981 - 30 Sep. 1982

W P GEREN Wright-Patterson AFB, Ohio AFWAL Dec. 1982 47 p refs

(Contract F33615-81-C-3409; AF PROJ 2402)

(AD-A127344; AFWAL-TR-82-3095) Avail NTIS HC A03/MF A01 CSCL 01C

An analytical model for calculating transfer functions relating the C-130 lightning sensor responses to incident electromagnetic fields was developed. The model consists of two components; a low frequency non-resonant term and a frequency-dependent term including airframe resonances. The latter are calculated for the frequency range 1-10 MHz and compared with measured data. Recommendations for removing airframe resonances from the measured data are presented Author (GRA)

N83-30414# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

MODERN DISPLAY TECHNOLOGIES FOR AIRBORNE APPLICATIONS

Apr. 1983 239 p refs Lecture series presented at London, 6-7 Jun. 1983, Rome, 9-10 Jun. 1983, and Fort Monmouth, N J, 16-17 1983

(AGARD-LS-126; ISBN-92-835-1449-1) Avail: NTIS HC A11/MF A01

Electronic displays for airborne application was discussed. Changes in display technology and applications which are evident in many fields, and result from the increasing use of digital data processors and the need to efficiently interface them to human operations are outlined. Topics discussed include human factors aspect of displays, cockpit environment, cathode ray tubes, image generation on matrix displays, light emitting diodes, liquid crystal displays, electroluminescent displays, vacuum fluorescent tubes, large area gas discharge displays or plasma displays and optical techniques for airborne displays.

N83-30415# Technische Hogeschool, Twente (Netherlands)

HUMAN FACTORS ASPECTS OF DISPLAYS

D BOSMAN In AGARD Mod. Display Technol for Airborne Appl. 28 p Apr 1983 refs Avail NTIS HC A11/MF A01

A total display system is a window, which permits the operator (pilot) to perceive the state and the dynamics of all the parameters which are relevant to this task is discussed. The performance of the visual interface between machine and brain is determined by technical and ergonomic factors. A basis for better interpretation of such data in assessing display performance specifications is described. E.A.K.

N83-30416# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics

COCKPIT ENVIRONMENT

W. M. HOLLISTER In AGARD Mod Display Technol. for Airborne Appl. 16 p Apr. 1983 refs

Avail. NTIS HC A11/MF A01

The cockpit environment where modern display technology is applied is described. Six display devices are discussed. Applications are classified according to their visualization format. E.A.K.

N83-30417# Thomson-CSF, Boulogne-Billancourt (France). Div. des Tubes Electroniques.

CATHODE RAY TUBES

J. P. MICHEL *In* AGARD Mod. Display Technol for Airborne Appl. 36 p Apr 1983 refs
 Avail: NTIS HC A11/MF A01

The cathode ray tube (CRT) is one of the earliest electro-optical devices. The basic CRT is divided into four electro-optical regions, plus the screen itself the electron beam formation region, the beam focusing region, and the drift region. The physical and visual characteristics are described. B.G

N83-30418# Technische Hogeschool, Twente (Netherlands)

IMAGE GENERATION ON MATRIX DISPLAYS

D. BOSMAN *In* AGARD Mod. Display Technol. for Airborne Appl. 17 p Apr. 1983 refs
 Avail: NTIS HC A11/MF A01

Images are two dimensional distributions of luminance $L(x,y)$ wherein x and y are the spatial (distance) coordinates of the local luminance L . The spatial resolution required for faithful reproduction of the image is determined by very steep luminance gradients and small radii curvature of contours, (at viewing distance seen at a solid angle of 0.5 minute) and by just noticeable L-differences (JND's) in low gradients. The required luminance resolution is determined by discernible luminance contrasts (3%). The performance and its limits of the CRT as used in both the recreational sector (television) and professional applications (such as aircraft displays), were extensively researched and described. The new generation of flat panel display devices have image generation properties which are sufficiently different from those of the CRT to require additional ergonomic investigations. In particular, the structural information (spatial domain) does not allow such operations as analogue low pass filtering based on partial overlap of pixels: the image remains tessellated because of the display technologies involved, wherein pixels are formed by reticulation of the light modulating or emitting display surface. Author

N83-30419# Marconi Avionics Ltd, Boreham Wood (England)

LIGHT EMITTING DIODES

D. PRICE and K. T. BURNETTE (Bunker Ramo Corp.) *In* AGARD Mod. Display Technol for Airborne Appl. 24 p Apr. 1983 refs
 Avail: NTIS HC A11/MF A01

The evolution of Light Emitting Diodes (LEDs) as a result of the initial search for materials suitable for the formation of improved quality diodes and transistors are reviewed. Any semiconductor having an energy band gap wide enough to support a visible radiative recombination process is a potential candidate for the fabrication of LEDs. Materials used successfully for the formation of light emitting diodes include SiC, a compound of Chemical Group 4 elements, several Group 3-5 compounds and several Group 2-6 compounds. Extreme difficulties experienced in forming pn diode junctions within Group 2-6 compounds resulted in the development of a metal-insulator-semiconductor electron injection structure that to date was in general characterized by relatively low light emission efficiencies. Light emitting diodes are being successfully applied to airborne numeric and alphanumeric display tasks with more sophisticated graphics displays designed for aircraft installation nearing completion. Author

N83-30420# Royal Signals and Radar Establishment, Malvern (England)

LIQUID CRYSTAL DISPLAYS

A. J. HUGHES *In* AGARD Mod. Display Technol for Airborne Appl. 17 p Apr. 1983 refs
 Avail: NTIS HC A11/MF A01

Although liquid crystalline materials were recognized for over 100 years, their potential in display devices has become apparent only during the last 15 years. In this time many different effects were discovered and assessed in laboratories, commercial exploitation was rapid and extensive, and a few displays were already fully developed for military use. The physical properties of liquid crystal materials and a selection of the more significant effects exploited in displays, pointing out their relative advantages

and limitations is described. The present state of the art is summarized and some tentative predictions for future performance are made. Author

N83-30421# Army Avionics Research and Development Activity, Fort Monmouth, N. J.

ELECTROLUMINESCENT DISPLAYS

B. GURMAN *In* AGARD Mod. Display Technol. for Airborne Appl. 31 p Apr. 1983 refs
 Avail: NTIS HC A11/MF A01

The principles of operation and physical/visual characteristics of electroluminescent displays are reviewed. The state-of-the-art in ac and dc, powder and thin film electroluminescent devices is described. M.G.

N83-30422# Thomson-CSF, Boulogne-Billancourt (France) Div. des Tubes Electroniques.

VACUUM FLUORESCENT TUBES

J. P. MICHEL *In* AGARD Mod. Display Technol for Airborne Appl. 8 p Apr 1983 refs
 Avail: NTIS HC A11/MF A01

The historical development and current state-of-the-art of vacuum fluorescent tubes is reviewed. The principles of operation, physical/visual characteristics, addressing/driving, and system interface are discussed. M.G.

N83-30423# Thomson-CSF, Boulogne-Billancourt (France) Div. des Tubes Electroniques.

LARGE AREA GAS DISCHARGE DISPLAYS OR PLASMA DISPLAYS

J. P. MICHEL *In* AGARD Mod. Display Technol for Airborne Appl. 17 p Apr 1983 refs
 Avail: NTIS HC A11/MF A01

Operating principles, physical and visual characteristics, addressing and driving, and system interface of both ac and dc plasma displays are discussed. The state of development and primary applications are also reviewed. M.G.

N83-30424# Royal Signals and Radar Establishment, Malvern (England)

OTHER TYPES OF DISPLAY

A. J. HUGHES *In* AGARD Mod. Display Technol. for Airborne Appl. 12 p Apr. 1983 refs
 Avail: NTIS HC A11/MF A01

A selection of newer and less well advanced display technologies that need further development before commercial or military acceptance are discussed. They are all non-emissive and include magnetooptic, magnetic particle, electrochemical, and various electro-mechanical displays. The properties and limitations of these various techniques are reviewed and compared with those of more established liquid crystal displays. R.J.F.

N83-30425# Royal Aircraft Establishment, Farnborough (England)

OPTICAL TECHNIQUES FOR AIRBORNE DISPLAYS

G. H. HUNT *In* AGARD Mod. Display Technol for Airborne Appl. 12 p Apr. 1983 refs
 Avail: NTIS HC A11/MF A01

Different types of optical designs used in airborne electronic displays are discussed in broad terms. The design constraints of each are noted. Optical filters, biocular magnifying displays, head-up displays, diffractive-optic displays, and multicolor displays are discussed. R.J.F.

N83-30426# Massachusetts Inst of Tech., Cambridge Dept. of Aeronautics and Astronautics

APPLICATIONS

W. M. HOLLISTER *In* AGARD Mod. Display Technol. for Airborne Appl. 9 p Apr. 1983
 Avail: NTIS HC A11/MF A01

Relative comparisons are made among various competing display technologies. Performance measures selected for comparison are summarized. Comparisons are made with regard to luminous intensity, reflectance, contrast, color, and resolution.

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Advantages and disadvantages are listed. An assessment of the potential of each technology for each application is summarized.

R J F

N83-31177 Syracuse Research Corp., N Y **MODELLING OF DIRECT-STRIKE LIGHTNING COUPLING BY A TRANSFER FUNCTION TECHNIQUE**

D. T. AUCLAND, R. F. WALLENBERG (Naval Air Systems Command), and J. A. BIRKEN /In FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec 9 p Jun 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

A transfer function approach is applied to the problem of lightning coupling into internal aircraft avionics circuits. This approach allows a systematic procedure for determining transient levels induced on interior aircraft circuits due to exterior interference fields such as those caused by nearby or direct strike lightning. Unique in the approach used here is the use of a triangular patch model for the exterior surface of the aircraft with all points of entry (POEs) closed. A moment method procedure is then used to find the 'short circuit' skin current in the frequency domain. This current interacts with all the POEs, described by either measured or theoretically calculated transfer functions, in a secondary interaction problem to create interior penetrating fields. These interior fields are used to derive distributed voltage and current sources which excite a transmission line model of a wire harness or cable bundle.

Author

N83-31188 Southwest Research Inst., San Antonio, Tex **ELECTROSTATIC VOLTAGE SENSORS FOR HELICOPTER DISCHARGERS**

O. TRANBARGER and B. M. DUFF /In FAA Eighth Intern. Aerospace and Ground Conf on Lightning and Static Elec. 34 p Jun. 1983 refs

(Contract DAAK51-79-C-0060)

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

To maintain hovering helicopters at safe energy levels, a noncontacting electrostatic sensor is required to accurately determine the voltage on the aircraft relative to ground and provide proper control data to an active discharger for neutralizing hazardous charging conditions. It is shown that a sphere suspended between two electrified ground planes and surrounded by space results in a theoretical relationship which shows how charge density, excess surface charge, and external electric fields affect the voltage on the sphere. Helicopter charge equilibrium conditions are specified from the theoretical and empirical analyses together with a methodology for determining the elastostatic coefficients of full scale hovering helicopters. It is found that active electrostatic discharger systems are now feasible for helicopter applications

E A K

N83-31602*# Honeywell, Inc., Minneapolis, Minn. Avionics Div **DEMONSTRATION ADVANCED AVIONICS SYSTEM (DAAS), PHASE 1 Final Contractor Report**

A. J. BAILEY, D. G. BAILEY, R. J. GAABO, T. G. LAHN, J. C. LARSON, E. M. PETERSON, J. W. SCHUCK, D. L. RODGERS (King Radio Corp., Olathe, Kansas), and K. A. WROBLEWSKI (King Radio Corp., Olathe, Kansas) Apr 1981 161 p (Contract NAS2-10021)

(NASA-CR-166503; NAS 1.26 166503) Avail: NTIS HC A08/MF A01 CSCL 01D

Demonstration advanced avionics system (DAAS) function description, hardware description, operational evaluation, and failure mode and effects analysis (FMEA) are provided. Projected advanced avionics system (PAAS) description, reliability analysis, cost analysis, maintainability analysis, and modularity analysis are discussed

Author

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AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A83-40864*# General Electric Co., Cincinnati, Ohio **BLADE LOSS TRANSIENT DYNAMIC ANALYSIS OF TURBOMACHINERY**

M. J. STALLONE, V. GALLARDO, A. F. STORACE, L. J. BACH, G. BLACK, and E. F. GAFFNEY (General Electric Co, Aircraft Engine Business Group, Cincinnati, OH) AIAA Journal (ISSN 0001-1452), vol. 21, Aug. 1983, p. 1134-1138. refs (Contract NAS3-22053)

Previously cited in issue 17, p. 2687, Accession no. A82-34982

A83-40865# **INFLUENCE OF ATOMIZER DESIGN FEATURES ON MEAN DROP SIZE**

N. K. RIZK (Cairo University, Giza, Egypt) and A. H. LEFEBVRE (Purdue University, West Lafayette, IN) AIAA Journal (ISSN 0001-1452), vol. 21, Aug. 1983, p. 1139-1142. refs

Previously cited in issue 17, p. 2687, Accession no. A82-34993

A83-41040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

JT9D PERFORMANCE DETERIORATION RESULTS FROM A SIMULATED AERODYNAMIC LOAD TEST

E. G. STAKOLICH (NASA, Lewis Research Center, Launch Vehicles Div., Cleveland, OH) and W. J. STROMBERG (United Technologies Corp., Pratt and Whitney Aircraft, East Hartford, CT) Journal of Aircraft (ISSN 0021-8669), vol. 20, Aug. 1983, p. 650-658.

Previously cited in issue 19, p. 3268, Accession no. A81-40963

A83-41482 **USE OF MIXED PERFORMANCE CRITERIA IN GAS TURBINE ENGINE CONTROLLER DESIGN**

P. J. FLEMING and C. W. JONES (North Wales, University College, Bangor, Wales) IN Control and its applications; Proceedings of the International Conference, Warwick, England, March 23-25, 1981. London, Institution of Electrical Engineers, 1981, p. 91-95. refs

A gas turbine engine is for thermodynamic reasons a highly nonlinear system. By means of a gradient minimization procedure, a highly efficient optimization approach is presently developed which includes the nonlinear system description directly in the design process and allows the use of nonquadratic terms in the performance index. The engine used in this design study is an Olympus twin-spool turbojet engine modeled as a fifth-order nonlinear dynamical system having two control inputs and a thrust output variable. The incorporation of nonquadratic terms in the performance index facilitates the use of mixed performance criteria, such as penalty function terms, to limit control variable behavior

O.C.

A83-41492 **REGULATOR DESIGN FOR THE F100 TURBOFAN ENGINE**

N. MUNRO (University of Manchester Institute of Science and Technology, Manchester, England) and S. ENGELL (Bochum, Ruhr-Universitaet, Bochum, West Germany) IN: Control and its applications; Proceedings of the International Conference, Warwick, England, March 23-25, 1981. London, Institution of Electrical Engineers, 1981, p. 380-387. refs

The problems posed for multivariable control theory by the F100 turbofan engine are approached by means of the Inverse Nyquist Array (INA) design method, together with scalar frequency domain methods. Attention is given to the difficulties encountered by Rosenbrock and Munro (1977) in their attempt to use the INA

method exclusively, in light of the good results presently obtained for the case of the closed loop system by means of both Bode plots and inverse Nyquist plots. O.C.

A83-41596

ESTIMATION OF THE THERMAL FATIGUE STRENGTH OF THE BLADES OF FULL-SCALE GAS-TURBINE ENGINES [K VOPROSU OTSENKI TERMOUSTALOSTNOI PROCHNOSTI NATURNYKH LOPATOK TURBINY GTD]

M. E. KOLOTNIKOV and S. I. STRILETS. Problemy Prochnosti (ISSN 0556-171X), July 1983, p. 15-17. In Russian.

The results of thermal fatigue tests on cooled gas-turbine blades made of ZhS6F alloy are examined. It is shown that the use of the known equations based on test results for a large variety of materials over a wide temperature range may lead to significant errors in estimating the residual thermal fatigue life of full-scale turbine blades. The principal parameters of a loading cycle and the effect of these parameters on the thermal fatigue life are discussed. V.L.

A83-41850#

METHOD OF THERMODYNAMIC FUNCTION CONTROL AND OF DAMAGE ANALYSIS REGARDING AIRCRAFT ENGINES WITH THE AID OF FLIGHT DATA RECORDING SYSTEMS [METHODEN DER THERMODYNAMISCHEN FUNKTIONSKONTROLLE UND DER SCHADENSANALYSE VON FLUGTRIEBWERKEN MIT HILFE VON FLUGDATENREGISTRIERSYSTEMEN]

W. KOSCHEL. Aachen, Rheinisch-Westfaelische Technische Hochschule, Fakultät fuer Maschinenwesen, Dr.-Ing. Dissertation, 1981, 218 p. In German. refs

Expenditures for engine maintenance operations comprise a large part of the total life cycle cost of an aircraft. Measures to reduce these expenditures form, therefore, a prominent part of efforts to reduce the life cycle cost as much as feasible. Such measures are partly related to changes in maintenance procedures from 'hard time maintenance' to 'on condition maintenance'. An essential condition for such a change is the existence of a suitable flight data recording system for monitoring engine conditions. Large hardware-related advances have been made concerning the development of such a system. There exist, however, a number of unresolved problems with respect to the provision of the required software. The present investigation has the objective to make a contribution toward an improvement concerning one of the software-related problem areas, taking into account theoretical and practical procedures for defect detection, fault diagnostics, and the early recognition of defects on the basis of a trend analysis. Aspects of thermodynamic power control are illustrated with the aid of an example involving the J79-MTU-J1K engine. G.R.

A83-42126

A CRITERIAL APPROACH TO ESTIMATING THE ACCUMULATION OF THE WORKING MEDIUM MASS AND ENERGY IN THE GAS-AIR CIRCUIT OF GAS-TURBINE ENGINES WHEN ANALYZING TRANSIENT REGIMES [KRITERIAL'NYI PODKHOD K OTSENKE NAKOPLENIIA MASSY I ENERGII RABOCHEGO TELA V OB'EMAKH GAZOVOZDUSHNOGO TRAKTA GTD PRI RASCHETE EGO NEUSTANOVIVSHIKHSIA REZHIMOV]

S. E. AKSELROD and V. M. KOFMAN. Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 7-11. In Russian.

The transient processes occurring in gas-turbine aircraft engines are investigated using computer simulation. General criterial relationships are obtained which describe the relative change in the operating parameters of a gas turbine due to the accumulation of the working medium mass and energy in the gas-air circuit. The threshold values of the criteria above which an allowance for mass and energy accumulation affects the simulation results are determined. V.L.

A83-42127

AN ANALYSIS OF THE PARAMETERS DETERMINING THE MAXIMUM THRUST OF RAMJET ENGINES [ANALIZ PARAMETROV, OPREDELAIOUSHCHIKH MAKSIMAL'NUI TIAGU PVRD]

V. I. BAZHANOV and A. A. STEPCHOKOV. Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 12-16. In Russian. refs

The maximum thrust of ramjet engines is determined by analyzing pressure losses in all engine elements. The variables used in determining the maximum thrust are those parameters that determine the engine configuration, i.e., the diffuser angle, the angle and the relative length of the combustion chamber, and the angle and the relative length of the nozzle. The maximum thrust is determined using the gradient method. Optimum design parameters are presented for ramjet engines in the Mach range 4-8. V.L.

A83-42129

A STUDY OF THE CHARACTERISTICS OF SHORT HYDRODYNAMIC DAMPERS OF AIRCRAFT ENGINE MOTORS WITH ALLOWANCE FOR TURBULIZATION OF THE WORKING FLUID IN THE DAMPER CLEARANCE [ISSLEDOVANIIE KHARAKTERISTIK 'KOROTKIKH' GIDRODINAMICHESKIKH DEMPFEROV ROTOROV AVIATSIONNYKH DVIGATELEI S UCHETOM TURBULIZATSII RABOCHEI ZHDKOSTI V DEMPFERNOM ZAZORE]

A. I. BELOUSOV, I. A. RAVIKOVICH, and V. B. BALIAKIN. Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 20-23. In Russian. refs

A method is proposed for calculating the dynamic characteristics of short hydrodynamic dampers for the case where lubricant flow in the damper clearance contains zones of turbulence. It is shown that the occurrence of turbulence in the working fluid leads to an increase in the hydrodynamic force and pressure amplitude in the damper clearance. This effect should be taken into account when designing hydrodynamic dampers for modern aircraft engines. V.L.

A83-42130

DETERMINATION OF FULL PRESSURE LOSSES IN STEPPED ANNULAR DIFFUSERS WITH RECTILINEAR OUTER WALLS AND A UNIFORM VELOCITY FIELD AT THE INLET [OPREDELENIIE POTER' POLNOGO DAVLENIIA V STUPENCHATYKH KOL'TSEVYKH DIFFUZORAKH S PRIAMOLINEINNYMI NARUZHNYMI STENKAMI I RAVNOMERNYM POLEM SKOROSTI NA VKHODE]

A. I. DANTSYG and N. M. PETROV. Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 24-28. In Russian. refs

Experiments have been carried out on a series of stepped annular diffusers with rectilinear outer walls in order to investigate the dynamics of gas flow and to determine full pressure losses. The experiments were conducted under conditions ensuring a uniform flow velocity field at the diffuser inlet, with the reduced inlet velocity ranging from 0.3 to 0.7. The experimentally determined pressure losses are presented in the form of polynomials of third degree. V.L.

A83-42132

CHARACTERISTICS OF THE OCCURRENCE AND ELIMINATION OF A STALL IN AN AXIAL-FLOW COMPRESSOR IN THE PRESENCE OF A ROTATING IRREGULARITY AT THE INLET [OSOBENNOSTI VOZNIKNOVENIIA I LIKVIDATSII SRYVA V OSEVOM KOMPRESSORE PRI NALICHII VRASHCHAIUSHCHEISIA NERAVNOMERNOSTI NA VKHODE]

L. A. KOZAREV and R. M. FEDOROV. Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 33-37. In Russian.

The characteristics of a two-stage axial-flow compressor with a large hub are investigated experimentally over a wide range of air flow rates including both stable and unstable operating conditions. A special rotating stall simulator is used to study the conditions existing at the inlet of the high-pressure stage of a two-shaft engine in the case of a stall in the low-pressure stage. It is shown that the effect of a rotating irregularity at the compressor

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inlet on the performance characteristics of the high-pressure stage is largely determined by the rotation frequency of the irregularity zone and that of the compressor rotor. V.L.

A83-42133

DIAGNOSTICS OF THE CONDITIONS OF GAS-TURBINE ENGINES USING MODELS REFLECTING THE DYNAMICS OF CHANGES IN THE CONTROLLED PARAMETERS [DIAGNOSTIKA SOSTOIANIIA GTD PO MODELIAM, OTRAZHAIUSHCHIM DINAMIKU IZMENENIIA KONTROLIRUEMYKH PARAMETROV]

B. M. KONIUKHOV, A. M. AKHMEDZIANOV, E. K. SHPILEVSKII, and V. T. SHEPEL Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 38-43. In Russian. refs

Identification models describing the dynamics of changes in the controlled parameters in terms of autoregression equations are used to diagnose the conditions of gas turbine engines. The problem of fault recognition is solved as a process classification problem in the time domain using the ideal observer criterion. The confidence level of fault detection and identification is shown to depend on the stage of learning and on the order of the selected model. V.L.

A83-42138

RESULTS OF AN EXPERIMENTAL STUDY OF THE THERMAL STATE OF BLADES IN TURBINES WITH PARTIAL ROOT COOLING [REZUL'TATY EKSPERIMENTAL'NOGO ISSLEDOVANIIA TEMPERATURNOGO SOSTOIANIIA LOPATOK TURBIN S PARTSIAL'NO-KORNEVYM OKHLAZHDENIEM]

A. I. ARKHIPOV, V. V. RUMIANTSEV, and N. G. LIPATOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 64-66. In Russian.

An experimental study of the temperature distributions of hollow blades in turbines with partial root cooling shows that the injection of cooling air into the root zone produces significant changes in the blade temperature. A substantial reduction of temperature is observed in the region adjacent to the blade root; some temperature reduction is also evident in the middle section of the blade. The temperature at the blade periphery, however, remains practically unchanged. The observed temperature distribution is explained not only by the heat conduction properties of the blade material and heat transfer in the cooling zone but also by changes in the gas temperature occurring in the gas-air mixing layer. V.L.

A83-42139

THERMODYNAMIC EFFICIENCY OF AIR INJECTION INTO THE RADIAL CLEARANCE OF THE TURBINE OF A TURBOJET ENGINE [O THERMODYNAMICHESKOI EFFEKTIVNOSTI VOZDUSHNOGO NADDUVA RADIAL'NYKH ZAZOROV V TURBINE TURBOREAKTIVNOGO DVIGATELIA]

E. N. BOGOMOLOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 66-70. In Russian.

The displacement of hot gases from the radial clearance of a turbine through the injection of air from the main compressor is a promising way of solving the problem of blade shroud cooling. Here, an analysis is presented of the effect of this method on the principal engine parameters. It is shown that air injection into the radial clearance is an efficient method of shroud cooling under both subsonic and supersonic conditions. V.L.

A83-42140

THE EFFECT OF SUPERCRITICAL PRESSURE GRADIENTS ON HEAT TRANSFER IN TURBINE NOZZLE CASCADES [VLIANIE SVERKHKRITICHESKIKH PEREPA DOV DAVLENNIIA NA TEPLOOTDACHU V SOPLOVYKH TURBINNYKH RESHETKAKH]

M. N. BODUNOV, I. I. IVANSHIN, and V. I. LOKAI Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 70-74. In Russian. refs

Heat transfer in nozzle vane cascades was investigated experimentally over a wide range of Reynolds (5×10 to the 5th - 2×10 to the 6th) and Mach (0.37-1.45) numbers, and the results were generalized on the basis of similarity theory. Typical

experimental data are presented for a cascade with an optimum pitch/chord ratio ($t/b = 0.66$). An expression is derived which makes it possible to determine heat transfer in cascades with pitch/chord ratios close to the optimum value. V.L.

A83-42146

EXPERIMENTAL INVESTIGATION OF A MODEL OF THE INTERNAL EXHAUST GAS MIXER CONFIGURATION OF A TURBOFAN ENGINE IN THE REVERSE-THRUST MODE [EKSPERIMENTAL'NOE ISSLEDOVANIE MODELI VYKHODNOGO USTROISTVA TRDD NA REZHIME OBRATNOI TIAGI]

E. V. DAVYDOV, O. M. ZHUKOV, V. V. ZAGVOZDKINA, B. D. FISHBEIN, and I. I. TSYBIZOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 88-91. In Russian.

The effect of geometrical parameters on the rarefaction and reduction of the thrust of the internal exhaust gas mixer configuration of a turbofan engine is investigated. General expressions are obtained showing the dependence of rarefaction at the afterburner section and the reduction of direct-thrust losses of the internal configuration upon dimensionless geometrical quantities. It is noted that knowledge of these dependences is necessary to design turbofan engines of the type studied. B.J.

A83-42150

A STUDY OF THE EFFECT OF THE COMBUSTION PROCESS ON MASS TRANSFER IN THE PRIMARY ZONE OF THE COMBUSTION CHAMBER OF A GAS-TURBINE ENGINE [ISSLEDOVANIE VLIANIIA PROTSESSA GORENIIA NA MASSOBMEN V PERVICHNOI ZONE KAMERY GTD]

M. P. KOLESOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 99-102. In Russian.

An experimental investigation of the primary zone of combustion chambers during combustion is often impractical, and such studies are in most cases conducted without combustion. Consequently, it is essential to know the effect of combustion on the process in the combustion chamber. Here, the effect of combustion on mass transfer in a vaporizing combustion chamber is investigated experimentally by feeding carbon dioxide through one of the ducts of a dual-duct fuel injector and estimating mass transfer from CO₂ axial velocities and concentrations. Numerical results are presented for excess air ratios equal to infinity (no combustion), 8.75 and 4.4. V.L.

A83-42151

INCREASING THE COMBUSTION EFFICIENCY OF FUEL IN AN AIR-HEATING CHAMBER OPERATING ON A PREVAPORIZED FUEL [POVYSHENIE POLNOTY SGORANIIA TOPLIVA V KAMERE PODOGREVA VOZDUKHA PRI RABOTE NA PREDVARITEL'NO ISPARENNOM TOPLIVE]

N. A. MALISHEVSKAIA, V. G. CHUMACHENKO, V. N. GRUZDEV, and I. E. KUZNETSOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p. 102, 103. In Russian.

Test results are presented for two designs of a fuel prevaporization system for the air-heating chamber of an afterburner. In the first scheme, fuel is evaporated in a coiled tube placed in a flow of combustion products from an auxiliary combustion chamber. In the second scheme, the vaporizing coil is placed in a flow of combustion products at the exit of the air-heating chamber. An analysis of the results shows that in combustion chambers operating in off-design regimes, the use of fuel prevaporization can significantly increase the combustion efficiency. V.L.

A83-42153

A STUDY OF THE GAS-DYNAMIC EFFICIENCY OF THE LABYRINTH SEALS OF GAS-TURBINE ENGINES WITH A PROFILED STATOR WALL [ISSLEDOVANIIE GAZODINAMICHESKOI EFFEKTIVNOSTI LABIRINTNYKH UPLOTNENII GTD S PROFIL'NOI STENKOI STATORA]

R. G. PERELMAN, V. G. NESTERENKO, and A. M. LIUBATUROV. *Aviatsionnaya Tekhnika* (ISSN 0579-2975), no. 1, 1983, p. 105-108. In Russian.

The use of a profiled stator wall in gas-turbine engines provides a way to reduce the clearance in the labyrinth seals. Here, the flow rate characteristics of such seals are investigated experimentally. In particular, experimental data are presented for honeycomb labyrinth seals tested in air at 15 C, with the pressure ratio varying from 1.2 to 3.0 and the radial clearance ranging from -1 to +1.5 mm. It is shown that the use of a local negative clearance, which is possible with honeycomb labyrinth seals, significantly reduces gas leakage. V.L.

A83-42154

MATHEMATICAL MODELING OF GAS-TURBINE ENGINES WITH HEAT REGENERATION [MATEMATICHESKOE MODELIROVANIIE GTD S REGENERATSIEI TEPLA]

A. N. PROKOFEV. *Aviatsionnaya Tekhnika* (ISSN 0579-2975), no. 1, 1983, p. 108-110. In Russian.

A known mathematical model (Druzhinin et al, 1979) for gas-turbine engines is extended to heat-regenerating gas turbines by introducing thermodynamic terms relating the flow parameters at the inlets and outlets of the heat exchanger. The model is validated by using it for the thermal analysis of a double-shaft gas-turbine engine with a rotating heat exchanger. In all cases, rapid convergence of the solutions is achieved. V.L.

A83-42524

PW100 - CANADA'S COMMUTER TURBOPROP

J. MOXON. *Flight International* (ISSN 0015-3710), vol. 124, July 23, 1983, p. 202-207.

The design characteristics and performance capabilities of the PW100 turboprop engine, which is scheduled to go into operation in two commuter airliners in 1983 and a third such aircraft in 1984, are presented. The PW100 is thermodynamically rated to 2270 shp, and is available with either a 1500 or 1800 shp gearbox. The engine employs an integral turbomachinery/gearbox structure. An efficiency of 80 percent is reported for the 12.5:1 pressure ratio compressor section, which consists of two centrifugal compressors, in tandem, each driven by its own single-stage turbine. A two-stage power turbine feeds the gearbox and propeller, in keeping with the desire for future power growth. Specific fuel consumption for the engine is 0.421 lb/hr/shp at 25,000-ft cruise altitude. O.C.

A83-42616

A FAMILY OF SMALL LOW COST GAS TURBINES FOR UNMANNED VEHICLE SYSTEMS

R. W. CHEVIS and I. J. GRANT (Noel Penny Turbines, Ltd., Coventry, England). (Royal Aeronautical Society and University of Bristol, International Conference on Remotely Piloted Vehicles, 3rd, Bristol, England, Sept. 13-15, 1982). *Aeronautical Journal* (ISSN 0001-9240), vol. 87, June-July 1983, p. 199-209. refs.

The eight engine types span a jet range of 50 to 1200 lbf sea level static thrust and a turboprop/turboshaft range of 15 to 450 SHP. The descriptions encompass turbomachinery, combustors, rotor assemblies and rotor dynamics, the lubrication system, alternators, fuel systems, and starting and ignition. Preliminary results from high-altitude qualification testing are presented. In general, no maintenance is required for expendable engines, although minimal attention may be required during long-term storage. For turbojets at the low end of the thrust range (50-350 lbf sea level static thrust) low cost is usually sought at the expense of frontal area by using the centrifugal compressor. At higher thrusts, the attainment of low frontal area becomes very important, and the more expensive axicentrifugal or all axial compressors are necessary. C.R.

A83-42877

THE STRENGTH OF GTE STRUCTURAL ELEMENTS UNDER LOW-CYCLE LOADING [PROCHNOST' ELEMENTOV KONSTRUKTSII GTD V USLOVIAKH MALOTSIKLOVOGO NAGRUZHENIIA]

N. D. KUZNETSOV. IN: Problems of mechanics and heat transfer in space technology. Moscow, Izdatel'stvo Mashinostroenie, 1982, p. 10-25. In Russian. refs.

Attention is given to such topics as the role of cyclic loading in the general structure of structural strength, the strength of GTE (gas turbine engine) structural elements under low-cycle loading, and the operational development of long-service-life GTEs. Analysis and test results pertaining to low-cycle fatigue in GTE parts are presented, and an assessment is made of the effects of operational, structural, and production factors on the resistance of widely used GTE materials to low-cycle loading. Consideration is given to newly developed fabrication processes directed toward improving the cyclic strength of GTEs and assuring the stability of their mechanical characteristics, as well as to techniques for the equivalent accelerated testing of full-scale long-life GTEs. B.J.

A83-43034

AERONAUTICAL RESEARCH - II. [LA RECHERCHE AERONAUTIQUE - II.]

J. MORISSET (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France). *Air et Cosmos* (ISSN 0044-6971), vol. 21, July 9, 1983, p. 15, 16. In French.

A83-43328

AEROACOUSTIC FLIGHT TEST OF FOUR SINGLE ENGINE PROPELLERS

G. M. GREGOREK, R. L. NEWMAN, and G. T. BLACK (Ohio State University, Columbus, OH). Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 9 p. refs.

(SAE PAPER 830731)

A flight test program has been conducted at the Aeronautical and Astronautical Research Laboratory (AARL) of The Ohio State University to measure performance and acoustic characteristics of four propellers designed for use on single-engine general-aviation airplanes. Three of the propellers were designed to reduce acoustic noise, while the fourth was a standard production propeller used for comparison. The tests show that noticeable reduction in near-field noise was achieved at a constant propeller rpm, and that comparable aircraft performance may still be maintained. Author.

A83-43694#

NONSYNCHRONOUS WHIRLS OF THE TURBINE ROTOR IN AEROJET ENGINES

J. GU and P. REN (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China). *Acta Aeronautica et Astronautica Sinica*, vol. 4, March 1983, p. 43-52. In Chinese, with abstract in English. refs.

Taking into account nonsynchronous whirls shown in aerojet engine vibration spectra as well as the details of engine construction, four possible major factors of self-excited vibration are examined. These include the unbalanced torque force caused by circumferential variations of blade tip clearance, the aeroelastic effect of the radial clearance of the labyrinth seal, the frictional force within spline couplings, and the nonlinear stiffness of the supports. The one-half order subharmonic vibration observed in engine tests is described, and its dynamic equations are deduced taking the overhung rotor as the mathematical model and considering the four abovementioned factors. Destabilizing factors are discussed for a specific type of aircraft engine, and the dynamics of the overhung low-pressure turbine rotor is addressed. It is shown that the frictional force within the spline couplings is the most important cause of self-excited vibrations, and that nonlinear stiffness of the back support transforms this vibration into autotracking one-half order subharmonic whirl. C.D.

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A83-43709

BRUSHLESS GENERATORS FOR REMOTE PILOTED VEHICLES

A WILLIAMS (HTL Electro-Kinetics, Inc., Santa Barbara, CA) IN Remotely piloted vehicles, International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 16.1-16.7

Attention is given to a variety of brushless electrical generator designs that may be employed as primary RPV electrical power suppliers when driven directly by the RPV propulsion system. Such generators are characterized by power generation in the stationary windings of the assembly, from which the electricity may be processed through a power control unit en route to vehicle loads, and are designed for a relatively short service life whether their RPVs are recoverable or expendable; thereby allowing the use of an inexpensive grease-lubricated bearing system. The generator types considered include the permanent magnet synchronous, flux switch, and combined homopolar/permanent magnet with either single or double magnets. O C.

A83-43711

LOW COST EXPENDABLE TURBOJET ENGINES

R. W. CROSS (Ames Industrial, Ltd., Fareham, Hants., England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Proceedings. Bristol, University of Bristol, 1982, p. 18.1-18.8.

The 108-daN turbojet engine developed for the expendable ASAT target RPV consists of a center section comprising a centrifugal compressor, a folded annular combustor, and an axial turbine, an air intake casing which supports engine accessories, and a jet pipe. Of prime importance was a reduction of engine weight without compromising RPV performance requirements, such as the survival of landing impacts. Attention was also given to fabrication cost reduction during design development, whose minimum operational life requirements stipulated 30 hours or 20 flights. The resulting engine has succeeded in meeting its design goals to the point where it may be uneconomical to repair. O C.

A83-43719

A RANGE OF LIGHTWEIGHT ENGINES FOR RPVS

D. P. SHORT (Normalair-Garrett, Ltd., Yeovil, Somerset, England) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers. Bristol, University of Bristol, 1982, p. 20.1-20.6.

Attention is given to a series of modular, lightweight, air-cooled two-stroke cycle engines intended for use by RPVs and other systems in which a high power/weight ratio is a major objective. The modular design principle allows two-, three-, and four-cylinder versions to be manufactured with a minimum of redesign and retooling. Low rotational speeds and minimum vibration are additional factors addressed by the present engine designs. The first engine developed has been a two-cylinder unit whose weight and dimensions are comparable to those of existing 274 cu cm-displacement engines, while yielding a minimum 25 percent greater power output, with the possibility of future development to a 75 percent increase over present, comparable engines. O C.

A83-43735

ADVANCED PROPFAN TESTBED - 'A' PROGRESS REPORT'

W. E. WARNOCK (Lockheed-Georgia Co., Marietta, GA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982, 27 p (SAWE PAPER 1453)

In recent years, the escalation of fuel prices has demonstrated the need for improved propulsive efficiency at high subsonic speeds, which in turn, has created renewed interest in propeller technology. Studies of the advanced turboprop propulsion system, the 'Prop-Fan', have shown that at altitudes of 30,000 ft and above at Mach numbers in excess of 0.8 the prop-fan can operate efficiently with fuel savings relative to turbofans of 20 to 35 percent. As the relative importance of fuel costs increases, these savings can result in Direct Operating Cost (DOC) reductions of 5 to 10 percent. Candidate propeller drive systems are discussed, taking

into account drive system design requirements, a power section survey, aspects of prop-fan sizing, and questions of drive system nacelle development. Attention is also given to candidate testbed aircraft design requirements, an aircraft survey, testbed aircraft configurations, testbed system evaluation, and recommendations. G R.

N83-30427*# United Technologies Corp., East Hartford, Conn. Commercial Products Div.

ENERGY EFFICIENT ENGINE LOW-PRESSURE COMPRESSOR COMPONENT TEST HARDWARE DETAILED DESIGN REPORT

C. J. MICHAEL and J. E. HALLE Jun. 1981 80 p refs

(Contract NAS3-20646)

(NASA-CR-165354, NAS 1.26:165354; PWA-5594-157) Avail NTIS HC A05/MF A01 CSCL 01E

The aerodynamic and mechanical design description of the low pressure compressor component of the Energy Efficient Engine were used. The component was designed to meet the requirements of the Flight Propulsion System while maintaining a low cost approach in providing a low pressure compressor design for the Integrated Core/Low Spool test required in the Energy Efficient Engine Program. The resulting low pressure compressor component design meets or exceeds all design goals with the exception of surge margin. In addition, the expense of hardware fabrication for the Integrated Core/Low Spool test has been minimized through the use of existing minor part hardware. Author

N83-30428*# Bionetics Corp., Hampton, Va.

AERODYNAMIC EVALUATION OF CIRCULATION CONTROL PROPELLERS

A. L. BRASLOW Jun. 1981 72 p refs

(Contract NAS1-14970)

(NASA-CR-165748; NAS 1.26:165748) Avail NTIS HC A04/MF A01 CSCL 01A

The aerodynamic compatibility of fixed-pitch circulation-control (CC) propellers with the performance characteristics and requirements of a 1600 kg (3600 lb) single-engine variable-pitch propeller general aviation airplane was evaluated. The initial results with elliptical-shaped CC airfoils indicated that the feasibility of application to fixed-pitch propellers was doubtful for the class of airplane investigated (cruise speed of about 300 km/hr) and improbable for higher-speed airplanes. Supplemental data for a cambered circulation-control supercritical airfoil, which became available after completion of the initial evaluation, were subsequently analyzed and are included in the Addendum to this report. With the much superior aerodynamic characteristics of the CC-supercritical airfoil, elimination of variable pitch appears aerodynamically feasible for low-speed airplanes through the use of a moderate amount of upper-surface blowing near the trailing edge during cruise. Overall feasibility depends upon results of structural and systems-type analyses. Author

N83-30429*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

ENERGY EFFICIENT ENGINE HIGH-PRESSURE TURBINE SINGLE CRYSTAL VANE AND BLADE FABRICATION TECHNOLOGY REPORT

A. F. GIAMEI, R. W. SALKELD, and C. W. HAYES Jul. 1981 112 p refs

(Contract NAS3-20646)

(NASA-CR-165400, NAS 1.26:165400; PWA-5594-152) Avail NTIS HC A02/MF A01 CSCL 21E

The objective of the High-Pressure Turbine Fabrication Program was to demonstrate the application and feasibility of Pratt & Whitney Aircraft-developed two-piece, single crystal casting and bonding technology on the turbine blade and vane configurations required for the high-pressure turbine in the Energy Efficient Engine. During the first phase of the program, casting feasibility was demonstrated. Several blade and vane halves were made for the bonding trials, plus solid blades and vanes were successfully cast for materials evaluation tests. Specimens exhibited the required microstructure and chemical composition. Bonding feasibility was demonstrated in the second phase of the effort. Bonding yields of 75 percent

for the vane and 30 percent for the blade were achieved, and methods for improving these yield percentages were identified. A bond process was established for PWA 1480 single crystal material which incorporated a transient liquid phase interlayer. Bond properties were substantiated and sensitivities determined. Tooling die materials were identified, and an advanced differential thermal expansion tooling concept was incorporated into the bond process
Author

N83-30430*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. Aircraft Engine Business Group

ENERGY EFFICIENT ENGINE. CORE ENGINE BEARINGS, DRIVES AND CONFIGURATION: DETAILED DESIGN REPORT
C L BROMAN Jun 1981 61 p refs

(Contract NAS3-20643)

(NASA-CR-165376, NAS 1.26:165376, R81-AEG-307) Avail: NTIS HC A04/MF A01 CSCL 21E

The detailed design of the forward and aft sumps, the accessory drive system, the lubrication system, and the piping/manifold configuration to be employed in the core engine test of the Energy Efficient Engine is addressed. The design goals for the above components were established based on the requirements of the test cell engine
Author

N83-30431*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INCIDENCE LOSS FOR FAN TURBINE ROTOR BLADE IN TWO-DIMENSIONAL CASCADE

J F KLINE, T P. MOFFITT, and R G. STABE Jul 1983 11 p refs

(NASA-TP-2188, E-1587, NAS 1.60 2188) Avail: NTIS HC A02/MF A01 CSCL 21E

The effect of incidence angle on the aerodynamic performance of a fan turbine rotor blade was investigated experimentally in a two dimensional cascade. The test covered a range of incidence angles from -15 deg to 10 deg and exit ideal critical velocity ratios from 0.75 to 0.95. The principal measurements were blade-surface static pressures and cross-channel survey of exit total pressure, static pressure, and flow angle. Flow adjacent to surfaces was examined using a visualization technique. The results of the investigation include blade-surface velocity distribution and overall kinetic energy loss coefficients for the incidence angles and exit velocity ratios tested. The measured losses are compared with those from a reference core turbine rotor blade and also with two common analytical methods of predicting incidence loss
Author

N83-30432*# Garrett Turbine Engine Co., Phoenix, Ariz
SCALED CENTRIFUGAL COMPRESSOR, COLLECTOR AND RUNNING GEAR PROGRAM Final Report

J G. KENEHAN 31 Mar. 1983 97 p refs

(Contract NAS3-22431)

(NASA-CR-168167, NAS 1.26:168167; GR-21-4269) Avail: NTIS HC A05/MF A01 CSCL 21E

The Scaled Centrifugal Compressor, Collector and Running gear Program was conducted in support of an overall NASA strategy to improve small-compressor performance, durability, and reliability while reducing initial and life-cycle costs. Accordingly, Garrett designed and provided a test rig, gearbox coupling, and facility collector for a new NASA facility, and provided a scaled model of an existing, high-performance impeller for evaluation scaling effects on aerodynamic performance and for obtaining other performance data. Test-rig shafting was designed to operate smoothly throughout a speed range up to 60,000 rpm. Pressurized components were designed to operate at pressures up to 300 psia and at temperatures to 1000 F. Nonrotating components were designed to provide a margin-of-safety of 0.05 or greater, rotating components, for a margin-of-safety based on allowable yield and ultimate strengths. Design activities were supported by complete design analysis, and the finished hardware was subjected to check-runs to confirm proper operation. The test rig will support a wide range of compressor tests and evaluations.
Author

N83-30433# Naval Research Lab., Washington, D C. Inorganic and Electrochemistry Branch

HOT CORROSION IN GAS TURBINES Interim Report

R. L. JONES 27 Apr. 1983 26 p refs

(AD-A127425, NRL-MR-5070) Avail: NTIS HC A03/MF A01 CSCL 21E

A review is presented which gives a brief, largely chronological overview of the development of the different theories of hot corrosion. This review was the Keynote Lecture for the Gas Turbine Session of the Symposium on Corrosion in Fossil Fuel Systems, Electrochemical Society Meeting, Detroit, MI, October 1982
Author (GRA)

N83-30434# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Gruppe Gesamtsysteme

COMPARISON OF A PROPFAN/TURBOFAN ENGINE BY THERMODYNAMIC CYCLE CALCULATIONS

P SCHIMMING Nov 1982 47 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-820)

(DFVLR-MITT-82-18; ESA-TT-820) Avail: NTIS HC A03/MF A01, DFVLR, Cologne DM 16,80

Thermodynamic cycle calculations were done for a propfan and turbopan propulsion system for a twin engine, medium range transportation aircraft to show the differences in specific fuel consumption. Common definitions for the efficiencies of propeller and fan and common handling in one cycle program were used. Results show 15% to 20% specific fuel consumption improvement, which depends on the mastering of interference between propeller stream and bearing surface.
Author (ESA)

N83-31603* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

CONTROL MEANS FOR A GAS TURBINE ENGINE Patent

R S BEITLER (General Electric Co., Cincinnati), F J SELLERS (General Electric Co., Cincinnati), and G. W. BENNETT, inventors (to NASA) (General Electric Co., Cincinnati) 6 Jul 1983 10 p Filed 26 Jun 1980

(NASA-CASE-LEW-14586-1; US-PATENT-4,338,061;

US-PATENT-APPL-SN-163122; US-PATENT-CLASS-415-1,

US-PATENT-CLASS-415-47; US-PATENT-CLASS-415-175;

US-PATENT-CLASS-415-178) Avail: US Patent and Trademark Office CSCL 21E

A means is provided for developing a signal representative of the actual compressor casing temperature, a second signal representative of compressor inlet gas temperature, and a third signal representative of compressor speed. Another means is provided for receiving the gas temperature and compressor speed signals and developing a schedule output signal which is a representative of a reference casing temperature at which a predetermined compressor blade stabilized clearance is provided. A means is also provided for comparing the actual compressor casing temperature signal and the reference casing temperature signal and developing a clearance control system representative of the difference. The clearance control signal is coupled to a control valve which controls a flow of air to the compressor casing to control the clearance between the compressor blades and the compressor casing. The clearance control signal can be modified to accommodate transient characteristics. Other embodiments are disclosed

Official Gazette of the U.S. Patent and Trademark Office

07 AIRCRAFT PROPULSION AND POWER

N83-31604# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

ENGINE PERFORMANCE COMPARISON ASSOCIATED WITH CARBURETOR ICING DURING AVIATION GRADE FUEL AND AUTOMOTIVE GRADE FUEL OPERATION Final Report, Jan. - Jul. 1982

W. CAVAGE, J. NEWCOMB, and K. BIEHL May 1983 114 p refs Original contains color illustrations (Contract FAA PROJ 184-320-120) (DOT/FAA/CT-82/110) Avail: NTIS HC A06/MF A01

Sea-level-static test cell engine operations were conducted utilizing a Teledyne continental Motors 0-200A engine and a Cessna 150 fuel system to review engine operational characteristics on 100LL aviation grade fuel and various blends of automotive grade fuel as well as carburetor ice detectors/warning devices sensitivity/effectiveness during actual carburetor icing. The primary purpose of test cell engine operation was to observe real-time carburetor icing characteristics associated with possible automotive grade fuel utilization by piston-powered light general aviation aircraft. In fulfillment of this task, baseline engine operations were established with 100LL aviation grade fuel followed by various blend of automotive grade fuel prior to imposing carburetor icing conditions and assessing operational characteristics Author

N83-31605# Ecole Polytechnique Federale de Lausanne (Switzerland) Lab. de Thermique Appliquee

AEROELASTICITY IN TURBOMACHINE-CASCADES Semiannual Progress Report, 1 Mar. - 31 Aug. 1982

P. SUTER and T. H. FRANSSON 10 Nov 1982 45 p refs (Contract AF-AFOSR-0251-81; AF PROJ 2307) (AD-A127709; AFOSR-83-0354TR; EPFL/LTA-TM-8-82; SAPR-2) Avail: NTIS HC A03/MF A01 CSCL 21E

A standardization nomenclature and reporting format, to be used for reporting format allows for both detailed comparison of the experimental and theoretical results, as well as for a direct judgment of the flutter tendencies of a specific turbomachine blading. A large number of (36) unsteady experimental data have been compiled, classified and evaluated. Out of these 36 data, 9 have been retained as possible test cases. Also the manifested by the fact that already 25 researchers (from the academic and industrial worlds) have announced their intentions to predict the aeroelastic behavior of one or several of the experimental test cases. An absence of well documented experimental data have been found, noticeable in the domain of high turning subsonic turbine blades and in the field of transonic/supersonic quasi-two-dimensional flat plate investigations. As regards to the high turning turbine blades, the Laboratoire de Thermique Appliquee has recently started such experimental work. GRA

N83-31606# Dayton Univ., Ohio Group for Impact Physics **STRUCTURAL ELEMENT AND REAL BLADE IMPACT TESTING, VOLUME 1 Final Report, Oct. 1977 - Jun. 1980**

R. S. BERTKE Wright-Patterson AFB, Ohio AFWAL Jan. 1983 469 p refs 2 Vol. (Contract F33615-77-C-5221; AF PROJ. 3066) (AD-A127744; AFWAL-TR-82-2121-VOL-1; UDR-TR-82-03-VOL-1) Avail: NTIS HC A20/MF A01 CSCL 14B

This report gives damage results of an experimental program concerned with performing nonrotating bench impact tests on test specimens ranging from simple cantilevered beams and plates to real fan blades. This study was carried out under Task VI Structural Element Tests which is part of the overall program Foreign Object Impact Damage Criteria. In the study, simple element specimens, such as beams and plates, were impact tested with progressive introduction of airfoil geometric parameters to validate experimentally the analytical predictions of Tasks V and VIII of the overall program. Impact tests were also conducted on actual fan blades to permit deriving correlation of the impact damage between the structural element specimens and full-scale blades. Data collected from the impact tests included accurate impact conditions, dynamic displacement of specimens at discrete points, strain/time histories local to the impact site and at critical blade stress regions identified from the structural response models,

pre-test and post-test material properties, and damage assessment. GRA

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AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities, piloting, flight controls; and autopilots

A83-40881

FLIGHT MANAGEMENT COMPUTERS (FMS) [LES CALCULATEURS DE GESTION DU VOL /FMS/]

M.-J. GROSSIN (Societe Nationale Industrielle Aerospatiale, Paris, France) (Instituts de Navigation, Congres International, Paris, France, Sept 21-24, 1982) Navigation (Paris) (ISSN 0028-1530), vol. 31, July 1983, p. 318-326. In French.

Features of flight management systems (FMS) for commercial aircraft are described. Automated aircraft navigation is accomplished through altitude sounding, automatic comparison of the resulting altitude with respect to a flight plan, reception of multiple signals from ground stations, or through zonal navigation. The ARINC system has been implemented in various forms on the 767, 757, A 310, and A 300-600 aircraft, which have computerized positioning capabilities. The total system includes a data base, processors for navigation calculations and control of related equipment, altitude calculation and flight profile optimization, a CRT, and an interface with the automatic pilot and the instrumentation. The memory contains the flight plans, turning points, radio aides, take-off and landing procedures, airport data, etc., thereby requiring up to 180,000 computer words. The memory can be held for up to 28 days with current systems, and can be modified. The automatic flight envelope corresponds to a program which maintains the aircraft in a flight regime that ensures optimized conditions, i.e., minimized costs. Finally, the CRT displays effectively replace most functions of the instrument panels on a single screen. M.S.K.

A83-40884#

CONTROL CONFIGURED VEHICLE AS A NEW GENERATION AIRCRAFT

K. T. MANI (Hindustan Aeronautics, Ltd., Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 35, Feb 1983, p. 23-31. refs

Technical advances, such as fly-by-wire, are being applied in aeronautics in order to optimize the configuration of the aircraft for its given mission requirement. It is pointed out that such optimization often leads to an aircraft, referred to as a control configured vehicle, that has a certain inherent static instability. A judicious use of advanced concepts for stability augmentation, automatic configuration management, and direct lift control can improve the thrust- and lift-limited maneuverability of the aircraft. Maneuver load control, flutter control, and gust alleviation can improve the structural efficiency and increase the lifetime. Stability augmentation is seen as promising the greatest gain, but this involves a significant technical risk in designing the required integrity into the longitudinal control system and ensuring that the added weight and cost do not nullify the benefits of increased aerodynamic efficiency. C.R.

A83-41073

COUPLED FLAP-TORSIONAL RESPONSE OF A ROTOR BLADE IN FORWARD FLIGHT DUE TO ATMOSPHERIC TURBULENCE EXCITATIONS

Y. K. LIN, J. E. PRUSSING (Illinois, University, Urbana, IL), J. S. FUH, and C. Y. R. HONG American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 3-12. refs (Contract DAAG29-81-K-0072)

An analytical procedure has been developed to compute the mean and mean square values of the flapping and torsional angles,

as functions of the azimuth position, of a rotor blade in forward flight under the excitations of atmospheric turbulence. The turbulence velocity components in the blade rotational plane appear in the coefficients in the coupled equations of motion, and the excitation velocities are replaced by white noise random processes and the state vector of the system response treated as a Markov random vector. Illustrative examples are given for eight cases with different combinations of system parameters and spectral levels of the turbulent velocities. It is found that the statistical average of the system response is nearly the same as the deterministic response, while the mean square response is strongly dependent on the levels of turbulence. The thrust coefficient affects only the flapping response, while the Lock number affects both the mean and mean square values of the response state variables in both the flapping and torsional modes. C.D.

A83-41078

THE EFFECTS OF ENGINE AND HEIGHT-CONTROL CHARACTERISTICS ON HELICOPTER HANDLING QUALITIES

L. D. CORLISS (U.S. Army, Army Research and Technology Laboratories, Moffett Field, CA) American Helicopter Society, Journal (ISSN 0002-8711), vol 28, July 1983, p. 56-62. refs

A ground-based simulation study was conducted on a large-scale motion simulator to study the effects in the vertical axis of engine response characteristics on handling qualities for a nap-of-the-earth (NOE) operating environment. This study concentrated specifically on the helicopter configuration with a speed-governed gas-turbine and expands previous work by focusing on aspects peculiar to rotary-wing and NOE operations. A wide range of engine response time, vehicle damping and sensitivity and excess power levels was studied. The data are compared with the existing handling-qualities specifications, MIL-F-83300 and AGARD 577, and in general show a need for higher minimums when performing such NOE maneuvers as a dolphin and bob-up task. Author

A83-41484

APPLICATION OF OPTIMAL CONTROL THEORY TO AIRCRAFT GUST LOAD ALLEVIATION

D. MCLEAN (Loughborough University of Technology, Loughborough, England) IN: Control and its applications: Proceedings of the International Conference, Warwick, England, March 23-25, 1981. London, Institution of Electrical Engineers, 1981, p. 158-162. Research supported by the Science Research Council of England. refs

It is possible to design gust load alleviation systems for aircraft which will simultaneously achieve both improved ride quality and structural load alleviation. The ride discomfort index is a straightforward formulation of the linear quadratic problem, and reductions of the rms values of normal acceleration of more than 30 percent are obtainable, simultaneously with reductions of the bending moments caused by the same gusts of 25 percent. The control law obtained from optimal linear theory is robust, and can provide useful load alleviation despite severe damage in the form of sensor or controller failures. O.C.

A83-41661#

ROBUST FAULT DETECTION, ISOLATION, AND ACCOMMODATION TO SUPPORT INTEGRATED AIRCRAFT CONTROL

R. L. KOSUT, R. A. WALKER, and S. C. SHAH (Integrated Systems, Inc., Palo Alto, CA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 14-21. (AIAA PAPER 83-2161)

Fault detection schemes to support integrated aircraft control must account for the effects of model errors. The underlying theory developed here is similar to recent advances in robust control and results in analytic tools that quantify the tradeoffs between model error and sensor failures. In particular, a detection scheme, which naturally arises from the theory, includes a filter whose purpose is to account for reference command transients and noise

levels in accordance with anticipated model error. Also, the theory identifies the minimum detectable failure in a given set of admissible failures. This minimum is a function of model errors, noise levels, and the class of reference commands. Calculation of this minimum is an essential step in a practical FDIA synthesis approach.

Author

A83-41669*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif.

FLIGHT-TEST RESULTS USING NONLINEAR CONTROL WITH THE F-8C DIGITAL FLY-BY-WIRE AIRCRAFT

R. R. LARSON, R. E. SMITH, and K. D. KRAMBEER (NASA, Flight Research Center, Edwards, CA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 97-110. (AIAA PAPER 83-2174)

The design and operation of the cooperative advanced digital research experiment (CADRE) to develop nonlinear pitch flight control algorithms is described, and the results of an in-flight evaluation using the F-8C digital fly-by-wire (DFBW) research aircraft are presented. The CADRE controller is described, including the initial filter, linear command prefilter, nonlinear command prefilter, and gain scheduling. The variable-integral control-to-optimize response of the controller is considered, and CADRE parameter combinations are addressed. The remotely-augmented-vehicle interface used in the DFBW aircraft experiment is discussed. The distant-tracking and close-formation tracking evaluation tasks for the aircraft are described along with evaluation configurations, and the test results are presented and discussed. The latter indicate that a nonlinear adaptive controller is a feasible control system technique for the fighter tracking task. C.D.

A83-41675#

ROBUSTNESS ANALYSIS OF A MULTILoop FLIGHT CONTROL SYSTEM

U.-L. LY (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 155-165. refs (AIAA PAPER 83-2189)

Design specifications for stability margins of multiloop flight control-law are usually expressed in terms of allowable phase and gain perturbations introduced at each feedback loop, while other loops are maintained closed at nominal gains. For design methodologies based on single loop closure, these criteria are adequate. Recent advances in multivariable control synthesis suggest a need for a more universal norm in testing design sensitivity to modelling uncertainties through the use of singular value analysis of the return-difference and the inverse return-difference matrices. Interpretation of the multiloop criterion with respect to single loop phase and gain margins is examined and drawback of the method delineated. In contrast to single-loop stability margins, allowable multiloop phase and gain perturbations derived from singular value analysis are quite conservative and vary with the scale units of the input (output) variables as demonstrated by a design problem in flight controls: a drone lateral attitude control. Author

A83-41678#

APPLICATION OF MONTE-CARLO TECHNIQUES TO THE 757/767 AUTOLAND DISPERSION ANALYSIS BY SIMULATION

A. SHAKARIAN (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 181-194. refs (AIAA PAPER 83-2193)

Reported in this paper is the summary of results and experience involving Monte Carlo simulations of the 757 and 767 autoland performance. Included are samples of flight test to simulator correlation and model(s)/statistical parameter descriptions. The

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statistical simulator results were used as an integral part of the FAA and CAA autoland certification process. Author

A83-41679*# Lockheed-California Co., Burbank. AN ADVANCED CONTROL SYSTEM FOR A NEXT GENERATION TRANSPORT AIRCRAFT

J. J. RISING, W. J. DAVIS (Lockheed-California Co., Burbank, CA), and W. D. GRANTHAM (NASA, Langley Research Center, Hampton, VA) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 195-209.

(AIAA PAPER 83-2194)

The use of modern control theory to develop a high-authority stability and control system for the next generation transport aircraft is described with examples taken from work performed on an advanced pitch active control system (PACS). The PACS was configured to have short-period and phugoid modes frequency and damping characteristics within the shaded S-plane areas, column force gradients with set bounds and with constant slope, and a blended normal-acceleration/pitch rate time history response to a step command. Details of the control law, feedback loop, and modal control syntheses are explored, as are compensation for the feedback gain, the deletion of the velocity signal, and the feed-forward compensation. Scheduling of the primary and secondary gains are discussed, together with control law mechanization, flying qualities analyses, and application on the L-1011 aircraft. M.S.K.

A83-41680# AN ELECTROMECHANICAL PRIMARY FLIGHT CONTROL ACTUATION SYSTEM FOR MILITARY TRANSPORT AIRCRAFT

K. C. THOMPSON (Lockheed-Georgia Co., Marietta, GA) and K. G. EITENMILLER (Sundstrand Corp., Rockford, IL) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 210-217. refs (AIAA PAPER 83-2195)

The test program goals and individual components performance criteria being examined to accumulate flight experience with an electromechanical actuation system for modern military transport aircraft are described. Consideration was limited to dual fully hydraulically activated surfaces and a large aircraft, such as the C-141 roll control. A completely all-mechanical system was included for use in the event of failure of both hydraulic systems. Details of the EMA components, interfaces, and electrical system parameters are provided, together with controller features such as the base drives, the inverter, brake, and voltage regulator. M.S.K.

A83-41683# STATUS AND CONCERNS FOR PREFERRED ORIENTATION CONTROL OF HIGH PERFORMANCE ANTI-AIR TACTICAL MISSILES

A. ARROW (Johns Hopkins University, Laurel, MD) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 236-244. refs (Contract N00024-83-C-5301) (AIAA PAPER 83-2198)

This paper provides a summary of the current status of autopilot development for anti-air preferred orientation control tactical missiles and identifies the associated critical coupling paths and parameters impacting stability and control characteristics. In general, classical skid-to-turn autopilot architectures have limited applicability for preferred orientation control configurations due to the increased severity of dynamic cross-channel coupling paths. Attention to air-frame design may alleviate the problem somewhat, but modified autopilot architectures may still be required to optimize performance. Technology issues related to development of autopilots and airframes with desirable characteristics are identified. Author

A83-41687# CLASSICAL VS. MODERN CONTROL SYSTEM DESIGN FOR TERMINAL GUIDANCE OF BANK-TO-TURN INTERCEPT MISSILES

C.-F. LIN (Wisconsin, University, Madison, WI) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 283-301. refs (AIAA PAPER 83-2203)

Bank-to-turn (BIT) steering is considered using both classical and modern control theories. BIT guidance command signals formulation, application of optimal guidance using linear dynamic model to obtain closed-loop guidance commands, and BIT autopilot design are discussed. Both conventional control approaches and nonlinear system inverse approach as applied to the BIT autopilot design are examined. Computation results of a six degree-of-freedom (6DOF) simulation for a BIT-90 deg control missile intercepting a lightweight, high thrust-to-weight ratio fighter are presented. Maneuvering target tracking algorithms are also included in the simulation. Author

A83-41697# INTEGRATED TASK-TAILORED CONTROL AUGMENTATION SYNTHESIS

D. K. SCHMIDT (Purdue University, West Lafayette, IN) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 378-385. refs (Contract AF-AFOSR-79-0042) (AIAA PAPER 83-2215)

An integrated control approach to synthesizing flight vehicle augmentation to operate optimally in parallel with the pilot to maximize pilot/vehicle performance is reviewed and applied to the multi-axis air-to-air tracking task. Both aircraft and active sight dynamics are included in the system, and multi-variable control laws are developed using a control theoretic approach to include pilot dynamic interactions with the system. The control laws obtained are evaluated via fixed-base simulations and significant increases in tracking performance, reduction in pilot workload, and improved pilot subjective ratings result. Author

A83-41699# AN INTEGRATED MANEUVER ENHANCEMENT AND GUST ALLEVIATION MODE FOR THE AFTI/F-111 MAW AIRCRAFT

D. C. NORMAN, R. J. HYNES (Boeing Military Airplane Co., Wichita, KS), and D. GANGSAAS (Boeing Commercial Airplane Co., Seattle, WA) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 391-403. (AIAA PAPER 83-2217)

The Advanced Fighter Technology Integration F-111 Mission Adaptive Wing (AFTI/F-111 MAW) is an F-111 aircraft which has been retrofitted with a variable camber (VC) wing and new control modes which utilize the capabilities of this advanced technology wing. The present investigation is concerned with the Maneuver Enhancement and Gust Alleviation (ME/GA) mode which has been designed to integrate the command augmentation and gust alleviation functions in such a way that the performance of each is not degraded by the presence of the other. The automatic modes are scheduled for flight test in 1984. The ME/GA mode is designed for a fixed wing sweep of 26 deg. Attention is given to design requirements, design problems, the synthesis process, and a performance summary. It is concluded that the presented fixed gain design provides excellent improvement in gust alleviation and command response over the existing augmentation system. G.R.

A83-41700#
AEROELASTIC INTERACTIONS WITH FLIGHT CONTROL (A SURVEY PAPER)

R. L. SWAIM (Oklahoma State University, Stillwater, OK) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 404-411. refs (AIAA PAPER 83-2219)

A review is given of some of the major advancements of the past thirty years in the design of flight control systems for elastic aircraft. The early research programs leading to the current Active Control Technology (ACT) and Control Configured Vehicles (CCV) applications are highlighted. The ACT/CCV functions include (1) Improved ride qualities, (2) Improved handling qualities, (3) Relaxed static stability, (4) Flutter suppression, (5) Structural loads reduction, (6) Structural fatigue life improvement. A selective, but extensive, reference list is included. Author

A83-41701#
CONTROL OF FORWARD SWEEP WING AEROELASTIC INSTABILITIES USING ACTIVE FEEDBACK SYSTEMS

T. E. NOLL (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), R. A. CALICO (USAF, Institute of Technology, Wright-Patterson AFB, OH), and F. E. EASTEP (Dayton, University, Dayton, OH) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 412-422. refs (AIAA PAPER 83-2220)

This investigation evaluated the aeroelastic instabilities associated with a forward swept wing, and the control of these instabilities using active feedback systems. Root locus design procedures and Pade polynomial approximations of the doublet-lattice unsteady aerodynamic force coefficients were used in the development of the various control laws. Feedback systems using two wing control surfaces were found to be the most promising for controlling, simultaneously, both the destiffening of the first bending mode of the forward swept wing (divergence for a cantilever wing and pitch/bending flutter for the free aircraft) and the higher frequency bending/torsion flutter mode classically associated with lifting surfaces. A leading edge control surface commanded by displacement feedback was used to prevent the instabilities related to the first bending mode while a trailing edge surface commanded by angular acceleration controlled a higher frequency bending/torsion flutter mode. These control laws resulted in large speed improvements and adequate gain margins at a design velocity. Phase margins were low but could be enhanced by a trade-off with speed improvement. Author

A83-41702*# Minnesota Univ., Minneapolis
ACTIVE FLUTTER SUPPRESSION USING EIGENSPACE AND LINEAR QUADRATIC DESIGN TECHNIQUES

W. L. GARRARD and B. S. LIEBST (Minnesota, University, Minneapolis, MN) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 423-431. refs (Contract NAG1-217) (AIAA PAPER 82-2222)

Eigenspace (ES) and Linear Quadratic (LQ) techniques are used to design an active flutter suppression system for the DAST ARW-2 flight test vehicle. The performance of the ES and LQ controllers are very similar in meeting control surface activity specifications. The ES controller provides reduced wing root bending moment and shear but torsional stress is slightly higher than with the LQ controller. The ES controller also results in improved flutter boundaries compared with the LQ controller. The LQ controller exhibits significantly better phase margins at the flutter condition than does the ES controller but the LQ design requires large feedback gains on actuator states while the ES does not. This results in reduced overall actuator gain for the LQ design. Author

A83-41709*# Purdue Univ., Lafayette, Ind
PILOT MODELING AND CLOSED-LOOP ANALYSIS OF FLEXIBLE AIRCRAFT IN THE PITCH TRACKING TASK

D. K. SCHMIDT (Purdue University, West Lafayette, IN) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 491-498. refs (Contract NAG1-254) (AIAA PAPER 83-2231)

The issue addressed in the appropriate modeling technique for pilot vehicle analysis of large flexible aircraft, when the frequency separation between the rigid-body mode and the dynamic aeroelastic modes is reduced. This situation was shown to have significant effects on pitch-tracking performance and subjective rating of the task, obtained via fixed base simulation. Further, the dynamics in these cases are not well modeled with a rigid-body-like model obtained by including only 'static elastic' effects, for example. It is shown that pilot/vehicle analysis of this data supports the hypothesis that an appropriate pilot-model structure is an optimal-control pilot model of full order. This is in contrast to the contention that a representative model is of reduced order when the subject is controlling high-order dynamics as in a flexible vehicle. The key appears to be in the correct assessment of the pilot's objective of attempting to control 'rigid-body' vehicle response, a response that must be estimated by the pilot from observations contaminated by aeroelastic dynamics. Finally, a model-based metric is shown to correlate well with the pilot's subjective ratings. Author

A83-41710#
HOVERING LIMIT CYCLES - A MAN-IN-THE-LOOP APPROACH

D. ANDRISANI, II (Purdue University, West Lafayette, IN), C. F. GAU, and S. M. BOURNE IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 499-508. refs (Contract N62269-81-C-0729) (AIAA PAPER 83-2232)

It is pointed out that man-in-the-flight-control-loop analysis has grown increasingly useful as a means of designing control systems to achieve desirable handling qualities. The present investigation deals with pilot models for a type of controlled element which is essentially K/S squared. A simple but nonlinear pilot model is proposed for the precision hovering task of a VTOL. The pilot model consists of one feedback gain on position error and a quantization nonlinearity on the pilot's stick positioning. Using this model, the pilot gain can be computed. The computed result agrees remarkably well with flight measurements. The resulting limit cycle motion also agrees well with flight measurements. G. R.

A83-41712*# National Aeronautics and Space Administration.
 Langley Research Center, Hampton, Va.

FLIGHT MANAGEMENT SYSTEMS - WHAT ARE THEY AND WHY ARE THEY BEING DEVELOPED?

J. F. CREEDON (NASA, Langley Research Center, Hampton, VA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 516-528. refs (AIAA PAPER 83-2235)

This paper presents the motivation for developing and using flight management systems. The architecture and theoretical basis of these systems is presented and their typical operation during a flight is described. Two computer programs developed to support flight management research are used to obtain numerical results which illustrate significant potential reductions in fuel used and/or airline operating costs which can be achieved through use of flight management systems. The specific levels of savings depend on the nature of the air traffic control system in which the aircraft operates. Accordingly, results are presented both for operations in the existing air traffic control system and in an air traffic control environment with reduced restrictions on airplane operations. The capability of airplanes equipped with suitable flight management systems to operate in a time-based (4-D) environment is also

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discussed. Programs of the Federal Aviation Administration which may influence the operation of flight management system equipped aircraft in the evolving National Airspace System are also briefly reviewed. Author

A83-41713#

FLIGHT MANAGEMENT SYSTEMS - WHERE ARE WE TODAY AND WHAT HAVE WE LEARNED?

R. E. SPRADLIN (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 529-537 refs (AIAA PAPER 83-2236)

A description is provided of the transition of commercial aircraft avionics from analog to digital in the decade preceding the decision to produce the 767 aircraft in 1978. A review is conducted of the events which led to the decision to make a major break with the industry-wide avionics design base and develop entirely new and fully integrated digital avionics. Attention is given to advanced laboratory and piloted simulation facilities, the design and testing of the Flight Management System (FMS), and certification to FAA and CAA standards. It is pointed out that the introduction of digital avionics into the 757 and 767 aircraft configurations has been a remarkable successful program. G.R.

A83-41714#

FLIGHT MANAGEMENT SYSTEMS III - WHERE ARE WE GOING AND WILL IT BE WORTH IT?

R. J. TIBOR and J. C. HALL (Rockwell International Corp., Pittsburgh, PA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 538-547. refs (AIAA PAPER 82-2237)

The current digital avionics on the modern transport aircraft of the 1980's have proven to be more reliable, easier to maintain, and more efficient than the equipments they replaced. Questions regarding the necessity of further changes are briefly considered. It is concluded that the technical improvements of the last few years provide already a basis for enhancing aircraft productivity and safety. Some insights into the future flight management systems are presented. Attention is given to developments in air traffic control, the national airspace system, airport facilities, engine and avionics technology, fiber optics, memory and processor trends, new display technologies, voice recognition systems, the processor architecture, software, aspects of redundancy, maintenance trends, and advantages of system integration. G.R.

A83-41716#

VERTICAL FLIGHT PATH AND SPEED CONTROL AUTOPILOT DESIGN USING TOTAL ENERGY PRINCIPLES

A. A. LAMBREGTS (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 559-569. refs (AIAA PAPER 83-2239)

A generalized automatic flight control system has been developed, that integrates all longitudinal flight path and speed control functions, previously provided by a pitch autopilot and autothrottle. In this design, a net thrust command is computed based on total energy demand arising from both flight path and speed targets. The elevator command is computed based on the energy distribution error between flight path and speed. The engine control is configured to produce the commanded net thrust. The design incorporates control strategies and hierarchy to deal systematically and effectively with all aircraft operational requirements, control non-linearities and performance limits. Consistent decoupled maneuver control is achieved for all modes and flight conditions without outerloop gain schedules, control law submodes or control function duplication. Author

A83-41728*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

RESTRUCTURABLE CONTROLS FOR AIRCRAFT

W. E. HOWELL, W. T. BUNDICK, R. M. HUESCHEN, and A. J. OSTROFF (NASA, Langley Research Center, Hampton, VA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 646-653 refs (AIAA PAPER 83-2255)

Future aircraft with highly sophisticated controls are likely to have multiple interdependent failure modes which will be difficult for the pilot to recognize. Such failures may lead to unanticipated sequences of events from which the pilot cannot intuitively recover. Advances in the state-of-the-art in failure detection, failure identification, and control system technology suggest it may be feasible to detect and identify potentially catastrophic failures in flight controls and to restructure the controls in real time to execute a safe landing. Two accidents are reviewed, one in which the pilot successfully restructured the controls and one in which he did not, but for which a solution existed. The problem requirements and potential theoretical techniques which apply are also discussed. Author

A83-41738#

ROBUSTNESS OF A DECOUPLED MULTIVARIABLE DIGITAL FLIGHT CONTROL SYSTEM

J. M. BAUSCHLICHER (USAF, Weapons Laboratory, Albuquerque, NM), J. J. DAZZO, and C. H. HOUPIS (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 708-718. refs (AIAA PAPER 83-2272)

This paper presents the results of a singular perturbation method in the design of a multivariable, error-actuated, digital flight control system. The controller is designed to accomplish decoupled six-degree-of-freedom maneuvers in order that the aircraft track appropriate command inputs. Augmented flight control surfaces enable the aircraft to develop direct side forces with the resulting capability of performing direct force maneuvers. The control system is used with the aircraft operating at three flight conditions: 0.6 Mach at sea level, 0.9 Mach at 30,000 ft, and 2.3 Mach at 40,000 ft altitude. At each flight condition the aircraft is commanded to perform seven decoupled maneuvers consisting of: pitch pointing, vertical translation, direct lift, yaw pointing, horizontal translation, flat turn and rollover. The responses demonstrate the ability of one fixed controller to perform satisfactorily for all of the seven decoupled maneuvers which are tested at the three selected flight conditions. Thus, the singular perturbation design method results in a controller that yields a robust system. Improved performance is achieved for individual maneuvers by permitting adjustment of the gains. Author

A83-41739*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

TRADEOFF STUDIES IN MULTIOBJECTIVE INSENSITIVE DESIGN OF AIRPLANE CONTROL SYSTEMS

A. A. SCHY (NASA, Langley Research Center, Hampton, VA) and D. P. GIESY (Kentron Technical Center, Hampton, VA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 719-728 refs (AIAA PAPER 83-2273)

A computer aided design method for multiobjective parameter-insensitive design of airplane control systems is described. Methods are presented for trading off nominal values of design objectives against sensitivities of the design objectives to parameter uncertainties, together with guidelines for designer utilization of the methods. The methods are illustrated by application to the design of a lateral stability augmentation system for two supersonic flight conditions of the Shuttle Orbiter. Objective functions are conventional handling quality measures and peak magnitudes of control deflections and rates. The uncertain

parameters are assumed Gaussian, and numerical approximations of the stochastic behavior of the objectives are described. Results of applying the tradeoff methods to this example show that stochastic-insensitive designs are distinctly different from deterministic multiobjective designs. The main penalty for achieving significant decrease in sensitivity is decreased speed of response for the nominal system. Author

A83-41740#

MIMO CONTROLLER DESIGN FOR LONGITUDINAL DECOUPLED AIRCRAFT MOTION

J. L. SPEYER, J. E. WHITE, R. DOUGLAS, and D. G. HULL (Texas, University, Austin, TX) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 729-737. Research supported by General Dynamics Corp. refs

(AIAA PAPER 83-2274)

For the AFTI/F16 a multi-input/multi-output (MIMO) controller design is described which decouples pitch rate and normal acceleration. A controllable state space is determined which forms the model used by the Linear-Quadratic-Gaussian (LQG) synthesis technique. The dynamic model guarantees zero steady state tracking, and the LQG synthesis technique produces the compensator structures with theoretical robustness guarantees. To ensure that the nominal system remains robust with respect to model and parameter uncertainties, singular value analysis is used. A combination of symmetric root locus, time response, and singular value analysis is used to describe the performance of the design. Author

A83-41765#

INTEGRATED FLIGHT CONTROL SYSTEMS DEVELOPMENT - THE F/A-18A AUTOMATIC CARRIER LANDING SYSTEM

J. M. URNES and R. K. HESS (McDonnell Douglas Corp., St. Louis, MO) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 920-930.

(AIAA PAPER 83-2162)

The F/A-18A Automatic Carrier Landing System integrates the aircraft flight control system, throttle control system, inertial navigation sensors and shipboard SPN-42 tracking radar and computer system to achieve fully automatic approach control to the carrier deck in all weather conditions. Accurate touchdown position and sink rate must be achieved under varying conditions of visibility, deck motion, air turbulence, and ship air wake down draft. Design analysis of this integrated digital control system is described, including digital synthesis methods used and projected performance under wind and deck motion conditions. Shipboard trials in January 1983 verified the high touchdown accuracy potential of the system, resulting in along-deck touchdown dispersion of only 22 ft for 63 automatic landings. Author

A83-41904*# Joint Inst. for Advancement of Flight Sciences, Hampton, Va.

DETERMINATION OF AERODYNAMIC PARAMETERS OF A FIGHTER AIRPLANE FROM FLIGHT DATA AT HIGH ANGLES OF ATTACK

V. KLEIN (Joint Institute for Advancement of Flight Sciences, Hampton, VA), J. G. BATTERSON (NASA, Langley Research Center, Hampton, VA), and I. ABBASY. American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 9 p. refs

(AIAA PAPER 83-2066)

A procedure for the estimation of airplane model structure and parameters is applied to data from a modern fighter airplane operating within an angle of attack range of 5 to 60 deg. The paper briefly describes the airplane, flight and wind tunnel data available, and the estimation method. The results presented contain basic longitudinal characteristics of the airplane and the estimates of aerodynamic parameters in the yawing-moment equations. These estimates are obtained from small and large amplitude maneuvers.

Because the latter set of data was not suitable for airplane identification, some of the large amplitude maneuvers were joined together and then partitioned into subsets according to the values of angle of attack. Each subset was then analyzed as a separate data set. Most of the estimated parameters and functions are in good agreement with the wind tunnel measurements. The estimated lateral parameters in the model equations also demonstrate good prediction capabilities. Author

A83-41905*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

AN APPLICATION OF PARAMETER IDENTIFICATION TO THE OSCILLATORY MOTION OF AN AIRPLANE AT HIGH C(L)

J. G. BATTERSON (NASA, Langley Research Center, Hampton, VA) and V. KLEIN (Joint Institute for Advancement of Flight Sciences, Hampton, VA). American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 9 p. refs

(AIAA PAPER 83-2067)

This paper presents an application of a stepwise regression incorporating polynomial splines to oscillatory flight data from a light research airplane operating at near stall angles of attack. It is shown that data from several experiments can be combined into a large data set for analysis and that hysteresis phenomena can be observed in this large data set. Finally, it is postulated from the analysis of the flight data and theoretical calculations that the observed oscillatory motion is the result of a combination of wing stall and wing wake position at the tail. Author

A83-41906#

COUPLED STATIC STABILITY ANALYSIS FOR NONLINEAR AERODYNAMICS

J. KALVISTE (Northrop Corp., Hawthorne, CA). American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 13 p. refs

(AIAA PAPER 83-2069)

Static stability for nonlinear aerodynamic data is analyzed by use of potential and kinetic energy relationships for rotational motion. An equivalent stability derivative is defined which has the same potential energy as the nonlinear data. The coupled equations of motion are decoupled by using local derivatives of nonlinear data. The analysis technique is then applied to the locally decoupled equations of motion and stability for nonlinear data is defined in terms of transient stability of nonlinear oscillations. Author

A83-41907*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

EFFECTS OF ROTOR INERTIA AND RPM CONTROL ON HELICOPTER HANDLING QUALITIES

L. D. CORLISS (NASA, Ames Research Center, U.S. Army, Aeromechanics Laboratory, Moffett Field, CA), C. L. BLANKEN (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA), and K. NELSON (Computer Sciences Corp., Moffett Field, CA). American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 8 p.

(AIAA PAPER 83-2070)

The effects of thrust-response characteristics on helicopter handling qualities have until recently remained largely undefined. A multiphase program is being conducted to study, in a generic sense and through ground simulation, the effects of engine and rotor response characteristics, excess power, and vertical damping on specific maneuvers included in nap-of-the-earth (NOE) operations. This paper describes the most recent of these phases: a simulation in which the effects on handling qualities of rotor inertia and rpm changes were considered. Thrust- and height-response characteristics to step-control inputs are included to document the configurations investigated. Results indicate that with a given engine response and unlimited power, large changes in rotor inertia have little effect on handling qualities for certain low-speed tasks and hover tasks. The effects on handling qualities of requiring the pilot to maintain proper rotor rpm limits were also studied. This investigation revealed that large fluctuations in rotor rpm degrade handling qualities; as a result, continued study of

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the use of methods to automate control of rotor rpm is recommended. Author

A83-41908#

SUGGESTED CHANGES IN LARGE AIRCRAFT FLYING QUALITIES CRITERIA

R T MEYER (Lockheed-Georgia Co., Marietta, GA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 8 p. refs

(AIAA PAPER 83-2071)

Changes in the US military flying-quality specifications for large (Class-III) aircraft, as embodied in the Background Information and User Guide of version C of MIL-F-8785, are proposed regarding longitudinal short-period frequency and acceleration sensitivity, longitudinal phugoid damping ratio, and allowable total-aircraft response delay. The lower boundary of the present control-anticipation parameter would be replaced by a static margin requirement of 3 percent at Level 1, a maneuver margin of 5 percent at Level 2, and a time to double amplitude of 6 sec at Level 3. The phugoid stability requirements would be ζ_P at least 0.02, ζ_P at least 0, and T_2 at least 6 sec, respectively, while response delay at the three levels would be 0.4, 0.6 and 0.7 sec. The need for further research on flying qualities and size effects is stressed. T K.

A83-41910#

COMPARISON OF THE BODE ENVELOPE CRITERION WITH OTHER CRITERIA

M. S. MELNYK, D. S. JOSHI, and J. HODGKINSON (Northrop Corp., Aircraft Div., Hawthorne, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 6 p. refs (AIAA PAPER 83-2073)

The Northrop longitudinal tracking Bode envelope criterion was compared with criteria proposed for the flying qualities Military Standard. The Bode criterion was somewhat less stringent than the bandwidth criterion and much more stringent than equivalent system criteria. Available data are insufficient to determine whether stringency improves flying qualities, but suggest that it increases control system complexity. Author

A83-41911*# Purdue Univ., Lafayette, Ind.

A MODAL ANALYSIS OF FLEXIBLE AIRCRAFT DYNAMICS WITH HANDLING QUALITIES IMPLICATIONS

D K. SCHMIDT (Purdue University, West Lafayette, IN) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 14 p. refs

(Contract NAG1-254)

(AIAA PAPER 83-2074)

A multivariable modal analysis technique is presented for evaluating flexible aircraft dynamics, focusing on meaningful vehicle responses to pilot inputs and atmospheric turbulence. Although modal analysis is the tool, vehicle time response is emphasized, and the analysis is performed on the linear, time-domain vehicle model. In evaluating previously obtained experimental pitch tracking data for a family of vehicle dynamic models, it is shown that flexible aeroelastic effects can significantly affect pitch attitude handling qualities. Consideration of the eigenvalues alone, of both rigid-body and aeroelastic modes, does not explain the simulation results. Modal analysis revealed, however, that although the lowest aeroelastic mode frequency was still three times greater than the short-period frequency, the rigid-body attitude response was dominated by this aeroelastic mode. This dominance was defined in terms of the relative magnitudes of the modal residues in selected vehicle responses. Author

A83-41920#

ON APPROXIMATING HIGHER-ORDER ROTOR DYNAMICS IN HELICOPTER STABILITY-DERIVATIVE MODELS

R S. HANSEN (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 12 p. refs

(AIAA PAPER 83-2088)

A primary objective of helicopter flight-test stability- and control-derivative extraction is to obtain results that are consistent with the theoretical quasi-static derivatives. A previous investigation, in which a model was identified from simulation data using the conventional six-degree-of-freedom stability-derivative model structure, showed that identified derivatives can differ considerably from those obtained by theoretical analysis. The fundamental reason for these discrepancies has been attributed to the lack of adequate modeling of the higher-order rotor (particularly flapping) dynamics. In this paper, several possible methods for including rotor-dynamic effects without making unacceptable increases in either the order of the system or the number of parameters to be identified are reported. It is shown that approximating rotor-dynamic effects yields identified derivative values that are more consistent with the theoretical quasi-static derivatives. Although the application is directed toward the helicopter, the methodology utilized can also be applied to flexible aircraft, unsteady aerodynamics, and highly augmented flight vehicles. Author

A83-41921#

SENSITIVITY OF DIGITAL FLIGHT CONTROL DESIGN TO PARAMETER ESTIMATION ERROR

W. R. WELLS and R. PAILOOR (Wright State University, Dayton, OH) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983 3 p.

(AIAA PAPER 83-2089)

A common difficulty in the design of many engineering control systems is the wide variation in system parameter values over the performance envelope. For high angle of attack flight, for instance, there exists a wide range of aerodynamic coefficients within the linearized model structure in addition to uncertainty in the estimated values of the stability and control derivatives. This paper considers the extent of the combined effects of sample rate and large parameter uncertainty in the design of feedback gains whenever digital computers are used as elements in the flight control system. Results are given for the case of optimal gain design for an autopilot considered as a linear regulator. Author

A83-41932#

STATUS OF THE DEVELOPMENT OF HANDLING CRITERIA FOR VSTOL TRANSITION

R H. HOH and M B. TISCHLER (Systems Technology, Inc., Hawthorne, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 8 p. refs

(AIAA PAPER 83-2103)

A fixed base piloted simulation was performed to identify potential handling quality-related problems for VSTOL transition from wing-borne to thrust supported flight. Attention was given to control system blending, coupling between pitch attitude and the transition controller, the effect of pitch attitude bandwidth, and the effect of transient instabilities during transition. It was found that the pilot technique during transition to hover involved controlling the altitude with the throttle and the closure rate with the nozzle angle. The significance of the control of the closure rate increased toward the end of transition. The pitch attitude bandwidth and the coupling between the transition controller and the pitch attitude were the critical transition factors because of the high sensitivity of the vertical rate to attitude changes.

M S K

A83-41933#**NEW FLYING QUALITIES CRITERIA FOR RELAXED STATIC LONGITUDINAL STABILITY**

J M SCHULER (Boeing Military Airplane Co., Advanced Airplane Branch, Seattle, WA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 12 p. refs
(Contract F33615-78-C-3603)
(AIAA PAPER 83-2104)

Data obtained by means of a fixed base simulator investigation of approach and landing, subsequently substantiated with available flight test data, are used in the development of novel flying quality criteria for relaxed static stability aircraft. The conventional time-to-double response amplitude is shown to be invalid, and attention is given to other pitch attitude-to-pitch control transfer function elements which must be incorporated in a flying quality assessment. Important parameters include the large negative real root and the positive real root which comprise the short period mode, the large zero parameter, and the control sensitivity. Criteria are developed on the basis of both open loop parameters and closed loop frequency response. O.C

A83-41934#**COMPARISON OF FIXED-BASE AND IN-FLIGHT SIMULATION RESULTS FOR LATERAL HIGH ORDER SYSTEMS**

J R WOOD (McDonnell Aircraft Co., St Louis, MO) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 8 p. refs
(AIAA PAPER 83-2105)

A fixed-base simulation replicated an in-flight investigation of the effects of high order dynamics on lateral handling qualities. The simulation was intended to compare fixed-base and in-flight simulation by producing a fixed-base lateral handling qualities data base. Two in-flight evaluation tasks, air-to-air gun tracking and HUD bank angle tracking, were examined to validate them as critical tasks for fixed-base simulation. The simulation data was compared to a criterion which used 'effective' roll mode time constant and time delay to determine in-flight pilot ratings. Differences between frequency domain 'equivalent' parameters and time domain 'effective' parameters were discussed. Author

A83-41935#**HANDLING QUALITIES CRITERIA FOR STOL FLIGHT PATH CONTROL FOR APPROACH AND LANDING**

D G MITCHELL and R. H. HOH (Systems Technology, Inc., Hawthorne, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 10 p. refs
(Contract F33615-80-C-3604)
(AIAA PAPER 83-2106)

Aircraft designed to operate in a short-takeoff-and-landing (STOL) environment require precise control over flight path. To achieve STOL performance, such aircraft have utilized powered lift or very low wing loading. Most STOL aircraft operate on the backside of the power required curve ($d\gamma/dV$ positive), and flight path control is achieved with throttle. However, in some cases augmentation has been employed to modify the characteristics of these aircraft to allow conventional piloting techniques. One of the primary challenges in developing a STOL amendment to the MIL Standard and Handbook has been to account for the many ways in which STOL aircraft can be flown. This paper reviews the criteria proposed for defining STOL flight qualities for flight path control during the terminal phases of light (final approach and landing). Author

A83-41936*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif.

FLIGHT TEST EXPERIENCE WITH PILOT-INDUCED-OSCILLATION SUPPRESSOR FILTERS

M F. SHAFER, R E SMITH, J. F. STEWART (NASA, Flight Research Center, Edwards, CA), and R E. BAILEY (Grumman Aerospace Corp., Bethpage, NY) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 17 p. refs
(AIAA PAPER 83-2107)

Digital flight control systems are popular for their flexibility, reliability, and power, however, their use sometimes results in deficient handling qualities, including pilot-induced oscillation (PIO), which can require extensive redesign of the control system. When redesign is not immediately possible, temporary solutions, such as the PIO suppression (PIOS) filter developed for the Space Shuttle, have been proposed. To determine the effectiveness of such PIOS filters on more conventional, high-performance aircraft, three experiments were performed using the NASA F-8 digital fly-by-wire and USAF/Calspan NT-33 variable-stability aircraft. Two types of PIOS filters were evaluated, using high-gain, precision tasks (close formation, probe-and-drogue refueling, and precision touch-and-go landing) with a time delay or a first-order lag added to make the aircraft prone to PIO. Various configurations of the PIOS filter were evaluated in the flight programs, and most of the PIOS filter configurations reduced the occurrence of PIOS and improved the handling qualities of the PIO-prone aircraft. These experiments also confirmed the influence of high-gain tasks and excessive control system time delay in evoking pilot-induced oscillations. Author

A83-41945#**POSTSTALL FLIGHT IN CLOSE COMBAT**

B JAERMARK (Saab-Scania AB, Linköping, Sweden) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983 6 p.
(AIAA PAPER 83-2120)

Due to modern aircraft technology it might be possible to fly at high angle of attack, far beyond the stall limit (poststall). This gives a new control quality of speed braking and opens for a new turning concept. During the last 3-4 years this feature has been discussed to be used in close aerial combat. This paper will focus on a particular simulation analysis in order to find out the advantages of using poststall in close combat. A hybrid computer set up gives the opportunity to scan through many cases and obtain an almost optimal solution in each case. With somewhat simplified models of the poststall as well as the conventional aircraft and with the goal to point at each other as soon as possible 75 different one-on-one combat engagements have been run through. The results are condensed in statistics, which show that the poststall feature gives significant advantages. However, there are still questions to be answered e.g. if the new concept can be used to its full extent in practice as it gives a very low speed and difficulties in maneuvering the aircraft, etc. Author

A83-41949#**DIVERGENCE SUPPRESSION SYSTEM FOR A FORWARD SWEEPED WING CONFIGURATION WITH WING-MOUNTED STORES**

M RIMER, R. CHIPMAN, and R. MERCADANTE (Grumman Aerospace Corp., Bethpage, NY) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 9 p. refs
(AIAA PAPER 83-2125)

The conceptual design of an active control system has been developed for an FSW configuration with stores to prevent the destiffening of the primary wing-bending mode with increasing divergence, thereby suppressing the inherent aeroelastic instability (divergence/body-freedom-flutter). The architecture includes wing-mounted and fuselage-mounted accelerometers to detect relative wing motion and an outboard wing flaperon to control this motion. By virtually eliminating the instability, the design enables the aircraft to carry significant wing-mounted stores while retaining

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the clean-wing flight envelope. On the CCV configuration studied (26 percent unstable), the system is a simple add-on to the existing flight control system and, based on a preliminary assessment, does not compromise longitudinal flying qualities. Author

A83-41950#

F/A-18 HIGH ANGLE OF ATTACK DEPARTURE RESISTANT CRITERIA FOR CONTROL LAW DEVELOPMENT

R. J. PELIKAN (McDonnell Aircraft Co., St. Louis, MO) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 7 p. (AIAA PAPER 83-2126)

The F/A-18 aircraft has a high lift wing. The lift characteristics in combination with high pitch rate capabilities provide a highly maneuverable aircraft. In order to take advantage of these characteristics, special departure and spin resistance properties had to be ensured. A summary is provided of the criteria used in the configuration basic airframe and the flight control system, giving attention to the static lateral/directional stability criteria used to develop F/A-18 resistance to high angle-of-attack departure and spin. It is found that departure resistance can be extended to the use of lateral directional control surfaces as well as to include position feedbacks. G.R.

A83-41951*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va

A SIMULATION STUDY OF THE LOW-SPEED CHARACTERISTICS OF A LIGHT TWIN WITH AN ENGINE-OUT

E. C. STEWART, T. M. MOUL, and P. W. BROWN (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 12 p. refs (AIAA PAPER 83-2128)

Potential safety advantages provided by the two engines on a light twin aircraft are not realized in practice as evidenced by recent engine-failure accident statistics. These statistics showed twice the fatality rate from engine failure for twins as for single-engine aircraft. The statistics showed also that one-half of the fatal engine-out accidents involved a stall. An improvement of the low-speed engine-out characteristics is, therefore, needed. An investigation of the engine-out characteristics of light twin-engine aircraft is currently being conducted as part of the comprehensive stall/spin program for general aviation aircraft. The present study is concerned with the first phase of this program. The primary objective of this study is to advance the understanding of the basic flight dynamics and piloting problems for an engine-out condition. An all-digital computer system was used in the conducted simulation study. G.R.

A83-41956*# National Aeronautical Establishment, Ottawa (Ontario).

SUBSONIC ROLL OSCILLATION EXPERIMENTS ON THE STANDARD DYNAMICS MODEL

M. E. BEYERS (National Aeronautical Establishment, Unsteady Aerodynamics Laboratory, Ottawa, Canada) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 10 p. refs (Contract NASW-3079) (AIAA PAPER 83-2134)

The experimental determination of the subsonic roll derivatives of the Standard Dynamics Model, which is representative of a current fighter aircraft configuration, is described. The direct, cross and cross-coupling derivatives are presented for angles of attack up to 41 deg and sideslip angles in the range from -5 deg to 5 deg, as functions of oscillation frequency. The derivatives exhibited significant nonlinear trends at high incidences and were found to be extremely sensitive to sideslip angle at angles of attack near 36 deg. The roll damping and dynamic cross derivatives were highly frequency dependent at angles of attack above 30 deg. The highest values measured for the dynamic cross and cross-coupling derivatives were comparable in magnitude with the maximum roll damping. The effects of oscillation amplitude and

Mach number were also investigated, and the direct derivatives were correlated with data from another facility. Author

A83-41961#

THE OPTIMAL EVASIVE MANEUVER OF A FIGHTER AGAINST PROPORTIONAL NAVIGATION MISSILES

F. IMADO and S. MIWA (Mitsubishi Electric Corp., Tokyo, Japan) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 9 p. refs (AIAA PAPER 83-2139)

The optimal evasive maneuver of a fighter against a proportional navigation missile is analyzed using α (angle of attack) and T (thrust) as the control variables. Following a preliminary analysis, the problem with a realistic missile and target nonlinear kinematics is numerically solved by the steepest ascent method. The results indicate that the optimal evasive maneuver in a two-dimensional plane is either vertical-S or split-S type. Minimum thrust arcs mainly appear in tail chase cases and the reason is analytically shown by using the maximum principle. Author

A83-41968#

FLAT SPIN OF BODIES WITH CIRCULAR CROSS-SECTION

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983. 11 p. refs (AIAA PAPER 83-2147)

An analysis is conducted of the experimental flat spin characteristics of bodies with circular cross section in order to determine the importance of the moving wall effects discussed by Ericsson (1980) compared to the local flow conditions considered by Kubota et al (1983). The flat spin phenomenon, which only occurs in the critical Reynolds number region, is found to be influenced greatly by moving wall effects, whereas the spin-induced change of the local environment has a much more modest effect. A simple analysis indicates that the reduced flat spin rate should remain approximately constant for a circular cylinder. G.R.

A83-43321

AN IMPROVED METHOD FOR PREDICTING LATERAL-DIRECTIONAL DYNAMIC STABILITY CHARACTERISTICS

H. S. BRUNER (Beech Aircraft Corp., Wichita, KS) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 8 p. refs (SAE PAPER 830711)

Current methods of predicting lateral-directional dynamic stability using closed form small perturbation equations are often inaccurate. Flight test data usually shows Dutch-roll characteristics; in particular, to be poorer than estimates. Two assumptions are inherent in these current methods that are inappropriate to General Aviation-type aircraft: first, that the control surfaces are fixed and, secondly, that the rate-of-change in sideslip (β dot) stability derivatives are insignificant. These assumptions are discarded in this new method, and the system of equations describing the aircraft motion are expanded. Solution of the eigenvalues and eigenvectors of this system of partial differential equations yield the characteristics of the airplane and control system motions. Comparison of the predictions with the new method to that of the old show significant differences. Particularly noteworthy is the strong influence of the β -dot terms on the damping of the Dutch-roll mode. Author

A83-43324

FAIL-OPERATIONAL DAFCS FOR BUSINESS/COMMUTER AIRCRAFT

R. C. ESLINGER (Sperry Corp., Sperry Flight Systems, Phoenix, AZ) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983. 9 p. (SAE PAPER 830714)

The fail-operational Digital Automatic Flight Control System (DAFCS) for business/commuter aircraft developed by Sperry

serves as the cornerstone in the new generation integrated cockpit. The DAFCS makes maximum use of digital technology by providing increased integration, performance, and flexibility along with an associated reduction in size, weight and power consumption. Tying together the DAFCS, sensors, and display systems is the Avionics Standard Communication Bus (ASCB). This bi-directional bus provides the interface with a minimum of hardware and aircraft wiring. This paper discusses system operation and DAFCS architecture along with a unique approach used to obtain fail passive performance in a single flight guidance computer.

Author

A83-43325

THE MISSING ELEMENT IN WIND SHEAR PROTECTION

S SAINT Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983 14 p. (SAE PAPER 830715)

The encounter of an aircraft at low altitude with wind shear can be extremely dangerous. A vital factor regarding this danger is related to the necessity that, in order to prevent a fatal accident, the pilot without any preceding warning, might have to perform the correct operations within a time of three or four seconds. A number of fatal accidents demonstrates that, in many cases, it is currently impossible for the pilot to satisfy this requirement under the given conditions. The present investigation is concerned with the details involved in wind shear occurrence and the approaches needed to save the aircraft and its occupants. It is concluded that under the considered conditions the only immediately available wind shear warning for the pilot can come from an on-board warning system which measures both the vertical and horizontal components of the shear and sounds the warning at the leading edge of the danger area. The best hope of escape can be provided by an integrated flight director system programmed to optimize the escape maneuver. Pilot training is another important factor

G.R.

A83-43327* National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

WING MODIFICATION FOR INCREASED SPIN RESISTANCE

H. P. STOUGH, D. J. DICARLO, and E. C. STEWART (NASA, Langley Research Center, Hampton, VA) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983 10 p refs (SAE PAPER 830720)

A simple wing leading-edge modification has been developed that delays outer wing panel stall, thus maintaining roll damping to higher angles of attack and delaying the onset of autorotation. The stall angle of attack of the outer wing panel has been shown to be a function of the spanwise length of the leading-edge modification. The margin of spin resistance provided by the modification is being explored through flight tests. Preliminary results have been used to evaluate spin resistance in terms of the difference in angle of attack between outer wing panel stall and the maximum attainable angle of attack.

Author

A83-43689#

INDUCED ROLLING MOMENT ON WINGS OF A MISSILE WITH TILT-WINGS IN 'X-X' CONFIGURATION AT SUPERSONIC SPEEDS

Q. YANG and Q. KANG (Harbin Shipbuilding Engineering Institute, Harbin, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, March 1983, p. 8-15. In Chinese, with abstract in English. refs

The aerodynamic loads on missile wings caused by aerodynamic interference with the deflection of the wings at certain angles have been studied on the basis of the slender-body theory as it applies to the problems of thickness, angle of attack, and side-slip angle. The equation for calculating the induced rolling moment on the wings has been formulated. It is found that the value of the induced rolling moment depends on the flight condition, the aerodynamic configuration, and the control of the missile. As usual, the value is small

C.D

A83-43809*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ESTIMATION OF PARAMETERS INVOLVED IN HIGH ANGLE-OF-ATTACK AERODYNAMIC THEORY USING SPIN FLIGHT TEST DATA

L. W. TAYLOR, JR. and B. N. PAMADI (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983 7 p refs (AIAA PAPER 83-2086)

The difficulty in applying parameter estimation techniques to spinning airplanes is due in part to the unwieldy number of possible combinations of terms in the equations of motion, when the model structure is unknown. The combination of high angle of attack and high rotation rate results in aerodynamic functions which are quite complex. For wing dominated configurations it is advantageous to use aerodynamic theory to generate the model structure. In this way, the number of unknown parameters is reduced and the model accuracy may be increased. Under conditions for which the theory is inadequate, however, model accuracy may be reduced. Strip theory, for example, is incapable of predicting autorotative rolling moments indicated by wind tunnel tests at angles of attack exceeding 40 degrees. An improved aerodynamic theory would be necessary to successfully apply the technique advanced for such regions.

Author

A83-43811#

ESTIMATION OF NONLINEAR AERODYNAMICS FROM TRANSPORT AIRPLANE CERTIFICATION MANEUVERS - A SYSTEM IDENTIFICATION APPROACH

T. J. GALBRAITH and D. A. KESKAR (Boeing Commercial Airplane Co., Seattle, WA) American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug. 15-17, 1983 7 p. refs (AIAA PAPER 83-2065)

This paper presents a method of investigating nonlinear aerodynamic effects in critical flight regimes from flight test data for a transport aircraft. The approach uses parameter identification techniques in conjunction with the concept of modeled process error to provide a functional representation of the nonlinear aerodynamics. Basic certification maneuvers for transport aircraft are used to derive the aerodynamics

Author

N83-30370# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

SOME MEASUREMENTS OF BUFFETING ON A FLUTTER MODEL OF A TYPICAL STRIKE AIRCRAFT

D. G. MABEY and B. E. CRIPPS In AGARD Ground/Flight Test Tech and Correlation 16 p Feb. 1983 refs Avail NTIS HC A23/MF A01

Some buffeting measurements on a flutter model of the wing of a typical strike aircraft are described and the results are compared with flight experiments. New criteria for light, moderate and severe levels of buffeting are proposed, to supplement previously derived empirical criteria. The results confirm that buffet penetration in flight is not limited by the severity of buffeting, but by handling limits. The wing of this model has a rigid body freedom in the low frequency roll mode, which clearly indicates wing-rock after buffet onset. Measurements of the response in this mode indicated that the buffet excitation was bounded, and comparable with that in the first symmetric bending mode, even when the aerodynamic damping in the roll mode was falling rapidly. The rapid fall, after buffet onset, of the aerodynamic damping in this low frequency rigid body mode was accurately predicted from steady pressure measurements. In marked contrast the measured increase, after buffet onset, of the aerodynamic damping for the first symmetric bending mode could not be predicted from steady pressure measurements. These observations have important implications for the prediction of buffeting in flight from measurements on models.

M G

N83-30374# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

CORRELATION ASPECTS IN THE IDENTIFICATION OF DYNAMIC EFFECTS USING COMPLEMENTARY TECHNIQUES FLIGHT IN TURBULENCE: GUST ALLEVIATION

K. WELHELM and R. VERBRUGGE (Inst. de Mecanique des Fluides) /n AGARD Ground/Flight Test Tech. and Correlation 22 p Feb 1983 refs

Avail: NTIS HC A23/MF A01

An overview of a research program underway at DFVLR-Braunschweig (FRG) and IMF-Lille (France) is presented. The goals of this program are (1) the comparison of complementary techniques by correlating their results, and (2) the modeling of aerodynamic transient effects which must be considered for aircraft flying in turbulence situations in connection with a gust alleviation system. The following techniques are applied in the program: theoretical prediction, static wind tunnel measurements, forced oscillation balance measurements, semi-free flight model tests (dynamic simulation in wind tunnel), catapult free-flight model tests, full-scale flight tests and system identification methods. A brief description of the different facilities is given, advantages and special problems associated with the application of the different test techniques are shown. Test results are presented and compared. Two alternate approaches for modeling aerodynamic transient effects are presented. The influence of the modeling of these effects on the efficiency of an open-loop gust alleviation system is shown.

Author

N83-30375# Institut de Mecanique des Fluides de Lille (France).

ASPECTS OF CORRELATION IN THE IDENTIFICATION OF DYNAMIC EFFECTS FROM COMPLEMENTARY TECHNIQUES: EVOLUTION AT HIGH ANGLES [ASPECTS DE LA CORRELATION DANS L'IDENTIFICATION D'EFFECTS DYNAMIQUES A PARTIR DE TECHNIQUES COMPLEMENTAIRES EVOLUTION AUX GRANDS ANGLES]

D. TRISTRANT /n AGARD Ground/Flight Test Tech. and Correlation 21 p Feb 1983 refs In FRENCH; ENGLISH summary

Avail: NTIS HC A23/MF A01

Some experimental and analytical methods which contribute to the comprehension and prediction of aircraft behavior at high angles of attack and stall/spin are presented. A combat aircraft can start a spin departure around an horizontal trajectory which becomes vertical after several spin turns. The comparison between such a spin and that observed in vertical wind tunnel on free flight model is not easy, particularly if these movements are agitated. A representation of high angle motions, visually giving the principal characteristics of the phenomena independently of the trajectory is suggested. Such a representation allows the correlation of spin motions between the vertical wind tunnel and the full scale flight. One of the basic parameters which could modify the quality of the correlation of spin tests realized in Froude similitude is the Reynolds number. With a typical example concerning a light aircraft, the important influence of Reynolds number on spin equilibrium state and the test method which allows one to understand and correlate the phenomena are shown. With a typical example concerning a combat aircraft, some measurement results on a dynamic balance are examined which allow the evaluation of the aerodynamic force system at high angle of attack, the modeling of aerodynamic effects and then spin simulations which can be compared with vertical wind tunnel results on free flight model.

Author

N83-30376# Army Aviation Research and Development Command, Moffett Field, Calif. Aeromechanics Lab.

DYNAMIC STRUCTURAL AEROELASTIC STABILITY TESTING OF THE XV-15 TILT ROTOR RESEARCH AIRCRAFT

L. G. SCHROERS /n AGARD Ground/Flight Test Tech. and Correlation 18 p Feb 1983 refs

Avail: NTIS HC A23/MF A01

Predicted aeroelastic characteristics are examined in light of the major parameters effecting rotor-pylon-wing stability. Flight test techniques used to obtain XV-15 aeroelastic stability are described. The flight test results are summarized and compared to the predicted values. In addition, a limited comparison of wind tunnel results, flight test results, and their correlation with predicted values is presented.

M. G.

N83-30379# Aeritalia S.p.A., Torino (Italy). Bruppo Velivoli da Combattimento.

CORRELATION PROBLEMS BETWEEN FLUTTER FLIGHT TEST DATA AND GROUND TESTS/CALCULATION RESULTS FOR A VARIABLE SWEEP WING AIRCRAFT

G. DEFERRARI, A. LOTZE (MBB), and R. PYRAH (British Aerospace Aircraft Group) /n AGARD Ground/Flight Test Tech. and Correlation 17 p Feb. 1983 refs

Avail: NTIS HC A23/MF A01

It was shown that especially in connection with nonlinearities, either generated by structural, control system or aerodynamic transonic effects, flutter clearance can not be based exclusively on flight testing nor on conventional flutter calculations. Flutter flight testing is a useful and required tool for flight clearance purposes but approaching areas with low flutter margins, good correlation with analytical investigations confirmed by ground resonance tests is vitally necessary, to be able to explain the physical behavior of the flutter case and to avoid unsafe conditions during flutter flight testing. If correlation between flight test and analysis is poor, possible nonlinear effects must be incorporated into the analysis. Having proven good correlation with flight testing for special test conditions, the clearance according to the most critical case during whole service life and considering all possible amplitudes has to be provided by analysis if this condition can not be reached by flight testing.

R. J. F.

N83-30380*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.

REAL-TIME FLUTTER ANALYSIS OF AN ACTIVE FLUTTER-SUPPRESSION SYSTEM ON A REMOTELY PILOTED RESEARCH AIRCRAFT

G. B. GILYARD and J. W. EDWARDS /n AGARD Ground/Flight Test Tech. and Correlation 15 p Feb. 1983 refs

Avail: NTIS HC A23/MF A01 CSCL 01C

Flight-test results of the first three flights of an aeroelastic research wing are described. The flight flutter-test technique used to obtain real-time damping estimates from fast-frequency sweep data was obtained and the open-loop flutter boundary determined. Nyquist analyses of sweep maneuvers appear to provide additional valuable information about flutter suppression system operation, both in terms of phase-margin estimates and as a means of evaluating maneuver quality. An error in implementing the flutter-suppression system required in a one-half nominal gain configuration, which caused the wing to be unstable at lower Mach numbers than anticipated, and the vehicle experienced closed-loop flutter on its third flight. Real-time flutter-testing procedures were improved.

R. J. F.

N83-30381# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

FLIGHT FLUTTER TESTING WITH EMPHASIS ON THE TIP VANE METHOD

H. ZIMMEMANN and R. DESTUYNDER (ONERA) /n AGARD Ground/Flight Test Tech. and Correlation 14 p Feb 1983 refs Previously announced as A83-18435

Avail: NTIS HC A23/MF A01

A short summary of the most important flight excitation systems developed and used in the last twenty years is given. Special

emphasis is put on the vane excitation system. This system was developed for the flight vibration tests of the A 310 intermediate-range transport aircraft. The general, functional, and safety requirements for this system are described. Also the preliminary tests, and the set-up and handling of such a system are reported. Because the vane excitation can be measured precisely, the tip vane method offers the advantage of representing aircraft response in terms of transfer functions rather than only autospectra. The transfer function so derived together with a multi-mode matching technique were then used to determine the frequencies and damping of the aircraft modes. The multi-mode matching technique is also described. The paper also reports some results obtained by flight vibration testing of the A 300 and A 310 aircraft
R.J.F.

N83-30435*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div
SUBSONIC-TRANSONIC STALL FLUTTER STUDY Final Report
H STARDTER Jun 1979 311 p refs
(Contract NAS3-20606)
(NASA-CR-165256, NAS 1.26.165256; PWA-5517-31) Avail
NTIS HC A14/MF A01 CSCL 01C

The objective of the Subsonic/Transonic Stall Flutter Program was to obtain detailed measurements of both the steady and unsteady flow field surrounding a rotor and the mechanical state of the rotor while it was operating in both steady and flutter modes to provide a basis for future analysis and for development of theories describing the flutter phenomenon. The program revealed that while all blades flutter at the same frequency, they do not flutter at the same amplitude, and their interblade phase angles are not equal. Such a pattern represents the superposition of a number of rotating nodal diameter patterns, each characterized by a different amplitude and different phase indexing, but each rotating at a speed that results in the same flutter frequency as seen in the rotor system. Review of the steady pressure contours indicated that flutter may alter the blade passage pressure distribution. The unsteady pressure amplitude contour maps reveal regions of high unsteady pressure amplitudes near the leading edge, lower amplitudes near the trailing
Author

N83-30718# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering
SUBCRITICAL FLUTTER TESTING USING THE FEEDBACK SYSTEM APPROACH
C D. TURNER /n Shock and Vibration Inform Center The Shock and Vibration Bull., No. 52 Part 3 p 145-157 May 1982 refs
Avail NTIS HC A12/MF A01 CSCL 01C

Current experimental flutter data analysis techniques assume an open-loop system for the aerodynamic and structural model. Frequency, damping, and modal energy are obtained from the experimentally obtained open-loop transfer function. These quantities are used directly or with other analytical methods to predict the critical flutter speed, or for use in subcritical analytical/experimental data comparisons. History has shown that the various techniques and methods are not always reliable. This paper presents an additional technique that represents the aerodynamic and structural model as a closed-loop or feedback system. The feedback system approach is compatible with most current techniques, with the only additional data requirement being the zero air speed transfer function which is obtained during the ground vibration test. In using this approach, two additional parameters are obtained for use in the prediction of the critical flutter speed or for subcritical data comparison, these are the aerodynamic transfer function and the product of the aerodynamic transfer function with the zero air speed transfer function. The development of the feedback system approach and its application to a simple and complex model are presented
Author

N83-30721# Indian Space Research Organization, Trivandrum Aerospace Structures Div.

SLV-3 FLIGHT VIBRATION ENVIRONMENT

S. A. PALANISWAMI, G. MUTHURAMAN, and P. BALACHANDRAN /n Shock and Vibration Inform Center The Shock and Vibration Bull., No. 52 Part 3 p 249-263 May 1982 refs
Avail NTIS HC A12/MF A01 CSCL 01C

The vibration test levels for SLV-3 were predicted based on empirical method. The second experimental flight of SLV-3 was instrumented at various locations to obtain actual vibration environment. The measurement scheme and data reduction are described. The various causes for the vibration are discussed in detail. The reduced levels from flight data are compared with predicted values
Author

N83-31234 British Aerospace Public Ltd. Co., Lancashire (England).

LIGHTNING PROTECTION DESIGN AND LIGHTNING THREAT FLIGHT CLEARANCE OF A FLY-BY-WIRE FLIGHT CONTROL SYSTEM FOR AN UNSTABLE AIRCRAFT

P. A. DOGGETT and I. P. MACDIARMID /n FAA Eighth Intern Aerospace and Ground Conf on Lightning and Static Elec. 10 p Jun 1983 refs
Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25 00

The design measures taken in the installation of a fly-by-wire system in a Jaguar aircraft relative to lightning strike protection are discussed. The whole aircraft simulated lightning strike tests carried out are briefly described, together with complementary bench tests. The experience gained is reviewed and used to provide a basis for a consistent philosophy of design and test
R.J.F.

N83-31607# Air Force Inst of Tech, Wright-Patterson AFB, Ohio. School of Engineering

DESIGN OF A MULTIVARIABLE TRACKER CONTROL LAW FOR THE A-7D DIGITAC 2 AIRCRAFT M.S. Thesis

R. N. PASCHALL Dec 1981 183 p refs
(AD-A127440; AFIT/GE/EE/81D-47) Avail NTIS HC A09/MF A01 CSCL 01C

This thesis uses the design procedures developed in an attempt to design a multivariable tracker control law for the A-7D Digitac II Aircraft. Some of the limitations and problems associated with this design procedure are uncovered in this study. A six degree-of-freedom aircraft model is developed and is then modified to a form that is required by the design procedure. The theory used for the design determines the necessary arrangement of the equations. A tracker control law is first designed for one flight condition. Then it is checked for robustness by applying the control law at a different flight condition and also by removing the rudder from the inputs. A design computer program called MULTI is developed to perform the computations and simulations. It is found that the design techniques are valid, but that they are not applicable to all systems. A problem occurs when the inputs, as with an aircraft, are bounded. Problems may also be encountered when the sensor and actuator models are incorporated into the design. Therefore, for this study, the sensor and actuator models are removed and approximated as unity
GRA

N83-31608# National Aeronautical Establishment, Ottawa (Ontario) Flight Simulator Lab

DEVELOPMENT OF THE MICROSAS LONGITUDINAL FLIGHT CONTROL SYSTEM FOR THE AUGMENTOR WING AIRCRAFT

S. KERELIUK, K. LUM, and W. E. B. RODERICK Feb 1983 38 p refs In ENGLISH, FRENCH summary
(AD-A128331; NRC-21066, NAE-AN-5) Avail NTIS HC A03/MF A01 CSCL 01C

A digital longitudinal stability augmentation system was designed and installed in the Augmentor Wing Research Aircraft by the Flight Research Laboratory of the National Aeronautical Establishment. This system partially replaced the computer-controlled control and display system called STOLAND owned by NASA Ames Research Center that was removed from

08 AIRCRAFT STABILITY AND CONTROL

the aircraft prior to its return to Canada. The computer system is described and the software flow charts are illustrated. Brief comments on the performance of the system during the flight test program are included. GRA

N83-31609# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A LATERAL-DIRECTIONAL CONTROLLER FOR HIGH-ANGLE-OF-ATTACK FLIGHT M.S. Thesis - Princeton Univ.

W. A. EHRENSTROM Mar. 1983 199 p refs
(AD-A128579; AFIT-CI-NR-83-12T) Avail NTIS HC A09/MF A01 CSCL 01B

A digital flight control system based on microprocessor technology has been designed, developed, and flight tested using the Avionics Research Aircraft (ARA). The control system utilizes the existing microprocessor system available in the aircraft's fly-by-wire control system. The command and stability augmentation control law was developed using modern control theory and is incorporated into existing flight control computer programs. Development of the model and control law, the gain scheduling procedure, and the flight test results are presented. The objective of the study was to provide lateral-directional stability during high-angle-of-attack flight and into the stall regime. Flight test results show that it is indeed possible to design a control system which will eliminate lateral-directional instabilities and do so at a level higher than the pilot was able to attain. GRA

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RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities, and engine test blocks

A83-41534

LARGE SCALE AEROENGINE COMPRESSOR TEST FACILITY

S. NAGANO and M. ICHIKAWA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IHI Engineering Review (ISSN 0018-9820), vol. 15, July 1982, p. 68-72

A general description is presented of a test facility for large compressors developed for the characterization of aircraft engine components. The facility includes a gas turbine driving unit, intake and exhaust systems for the test compressor, and a data acquisition system. This facility is capable of testing compressors up to 18,000 SPS with a maximum speed of 13,000 rpm. The whole system is compactly designed, and the data acquisition system includes minicomputers and pressure/temperature measuring devices which provide on-line computing of the measured data for instant display of the overall performance of the compressor as well as detailed aerodynamic properties of the internal flow field. N.B.

A83-41667#

SIMULATOR APPLICATIONS AND TECHNOLOGY

D. J. GIBINO (USAF, Strategic/Airlift Div., Wright-Patterson AFB, OH) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, 1983, p. 75-77 (AIAA PAPER 83-2172)

Simulator applications and the major subsystems of training flight simulators are summarized, and the handling quality issues most often encountered in development and pilot acceptance are briefly reviewed along with the handling-quality related research programs which the simulator SPO is participating in. The roles of the crew station, computational subsystem, instructor station, sensor simulation, motion cueing subsystems, control loading subsystem, and visual system are mentioned. The influence of aircraft data, motion perception, visual perception, and transport lag on a pilot's evaluation of a simulator are described. The planned

'Handbook of Perception and Human Performance', g-seat study, motion drive study, aircraft/simulator handling behavior comparison, simulator transport delay study, and in-flight simulator analysis are described. C.D.

A83-42549#

DESIGN AND EXPERIMENTATION WITHIN THE MOBILITY DEVELOPMENT LABORATORY (MDL) UTILIZING THE STATIC AND DYNAMIC TEST MACHINES

F. RALSTON and G. WYEN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings New York, American Institute of Aeronautics and Astronautics, 1983, p. 7-4-1 to 7-4-3.

An In-House effort was initiated to develop a facility and the necessary test machines to determine the static and dynamic characteristics of Air Cushion Systems (ACS's) and other advanced mobility systems including conventional landing gear concepts through tests of dynamically scaled models. This requirement dictated that test machines be designed, fabricated and built to perform tests during vehicle taxi, takeoff and landing over various ground surfaces and positive and negative obstacles of varying size and shape. To cover this proposed test matrix, two test machines were developed; the Static Test Platform and the Dynamic Test Machine. Author

A83-42563#

GAS TURBINE ENGINE CASCADE WIND TUNNEL WITH AUTOMATIC DATA ACQUISITION AND CONTROL

W. C. ELROD (USAF, Institute of Technology, Wright-Patterson AFB, OH), D. M. ALLISON, and J. A. VONADA IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings New York, American Institute of Aeronautics and Astronautics, 1983, p. 13-7-1 to 13-7-5.

A facility for investigating performance of compressor and turbine blade cascades at Reynolds numbers up to three million per foot will be described. The AFIT/ENY Data Acquisition System is used to control the gathering, analysis, and display of the data in various forms. The data acquisition system included a computer with an interface system that allows software control of a traversing mechanism designed to position the velocity measuring sensor. An X-sensor hot wire anemometer is used to determine the velocity field characteristics downstream from the compressor cascade. Blade profile, surface roughness and trailing edge configuration as well as cascade geometry may be varied. Author

A83-42623

HEAVY GAS MIXTURES FOR WIND TUNNEL USE

S. K. J. AL-ANI and E. A. JOHNSON (Surrey, University, Guildford, England) Aeronautical Journal (ISSN 0001-9240), vol. 87, June-July 1983, p. 237-240. refs

The advantages of using heavy gases in wind tunnels, that is, reduced power consumption and scale size, were established by the study by Smelt (1945). To ensure correct scaling of the results from such a tunnel, the working fluid should have a specific-heat-ratio gamma equal to that of air (gamma = 1.4). It is noted that such a fluid can be obtained as a mixture of a monatomic gas with a polyatomic one. General mix principles for choosing such a mixture are discussed, and estimates are made of the savings in size and scale that may be expected in comparison with a conventional tunnel. The study is based on earlier work by Chapman (1954). C.R.

A83-43724

RECOVERY SYSTEM FOR THE LOCKHEED AQUILA R.P.V.

S. EISELE (Dornier GmbH, Friedrichshafen, West Germany) IN: Remotely piloted vehicles; International Conference, 3rd, Bristol, England, September 13-15, 1982, Supplementary Papers Bristol, University of Bristol, 1982, p. 28.1-28.9

The Aquila RPV's recovery subsystem consists of a net suspended from two arms of a crane-like structure that can be

hydraulically erected, retracted, and rotated in four positions in order to accommodate wind direction and solar radiation. Automatic recovery is accomplished by two guidance cameras mounted on the structure, which track a pulsed IR beacon emitted by the incoming RPV. At the moment of recovery, the net envelops the RPV and absorbs its kinetic energy by transmitting it to decelerator equipment via brake cables. System testing began in 1980, and has demonstrated the meeting of all design requirements O.C.

N83-30372* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

HELICOPTER SIMULATION VALIDATION USING FLIGHT DATA

D. L. KEY (Army Research and Technology Labs.), R. S. HANSEN (Army Research and Technology Labs.), W. B. CLEVELAND, and W. Y. ABBOTT (Army Aviation Engineering Flight Activity) /in AGARD Ground/Flight Test Tech and Correlation 13 p Feb. 1983 refs

Avail: NTIS HC A23/MF A01 CSCL 14B

See N83-13112.

Author (IAA)

N83-30436# Canada Inst. for Scientific and Technical Information, Ottawa (Ontario).

CONSTRUCTION OF AN ICE MODEL BASIN AT THE SHIP RESEARCH INSTITUTE OF THE MINISTRY OF TRANSPORTATION

K. KAMURA and M. TAKEUCHI 1983 45 p Transl into ENGLISH of rept. no. 114 Mitsui Shipbuilding Co., Inc., (Japan) p 91-102

(NRC/CNR-TT-2066, ISSN-0077-5606) Avail. NTIS HC A03/MF A01

A water tank designed to artificially reproduce icy sea conditions was built. This ice model test basin was constructed in an insulated building and a cooling system was installed to make the water in the tank freeze at its surface. Special consideration was given to the basic design and insulation of the building and the basin so as to ensure that they could withstand rapid and repeated temperature changes. Author

N83-30437# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

SUPERSONIC NOZZLE DESIGN FOR A LOW DENSITY WIND TUNNEL

R. B. ABRAO and N. S. VENKATARAMAN May 1983 13 p To be presented at the 7th Congr. Brasil de Eng. Mecan., Uberlandia, Brazil, 13-16 Dec. 1983 (INPE-2753-PRE/329) Avail: NTIS HC A02/MF A01

A method to determine the contour of an axisymmetric nozzle of a low density wind tunnel, to produce a supersonic, parallel and uniform flow in the test section is described. The method of characteristics is used to obtain the isentropic profile which is then corrected for boundary layer growth. The influence of the nozzle geometry on the flow parameters is analyzed. Author

N83-30438* National Aeronautics and Space Administration, Washington, D. C.

WEATHER HAZARD SIMULATION IN THE MODANE WIND-TUNNELS

G. FASSO, G. LECLERE, and F. CHARPIN Apr 1983 20 p refs Transl. into ENGLISH of "Simulation des Intemperies dans les Souffleries de Modane" rept. AGARD-CP-174 Paris, Mar. 1976 8 p Fluid Dyn. Panel Symp. held in London, 6-8 Oct 1975 Document was also announced as N76-25244 Transl. by Kanner (Leo) Associates, Redwood City, Calif (Contract NASW-3541)

(NASA-TM-77069, NAS 1.15:77069, AGARD-CP-174) Avail: NTIS HC A02/MF A01 CSCL 14B

Specially designed wind tunnel setups make it possible to simulate various weather hazards, in an imperfect but systematic manner. Systems installed in the Modane wind tunnels for rain and icing tests are described. A gust simulator being developed is also discussed. Author

N83-30439* National Aeronautics and Space Administration, Washington, D. C.

CONVERGENCE BEHAVIOR THAT CONTROLS ADAPTIVE WIND TUNNEL WALLS NEAR THE TEST SECTION IN THE HIGH ANGLE OF ATTACK RANGE

J. ZIEMANN Nov. 1982 80 p refs Transl. into ENGLISH of "Das Konvergenzverhalten der Regelung Adaptiver Windkanalwände bei Profilveränderungen im Hochanstellwinkel-Bereich" rept. ILR-Mitt-66-(1980) Technische Universität, Berlin, Jan 1980 p 1-76 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASW-3542)

(NASA-TM-77006; NAS 1.15:77006; ILR-MITT-66-(1980)) Avail NTIS HC A05/MF A01 CSCL 14B

The NACA 0012 profile at Mach 0.5 was investigated in a wind tunnel with adaptive walls. It is found that adaptation of the flexible walls is possible in the high angle of attack range on both sides of maximum lift. Oil film photographs of the flow at the profile surface show three dimensional effects in the region of the corners between the profile and the sidewall. It is concluded that pure two dimensional separated flow is not possible. Author

N83-30440# BDM Corp., McLean, Va

RAPID RUNWAY REPAIR PROGRAM SUBTASK 1.08. CONCRETE CUTTING EQUIPMENT EVALUATION Final Report, Jul. 1981 - Sep. 1982

R. K. MOATS, R. DUCHATELLIER, and B. N. THAKUR Tyndall AFB, Fla Air Force Engineering and Service Center 1 Mar 1983 85 p

(Contract F08635-80-C-0206, AF PROJ. 2104)

(AD-A127336; AFESC/ESL-TR-82-40; BDM/W-82-505-TR) Avail NTIS HC A05/MF A01 CSCL 131

Diamond saws were identified in earlier studies as a promising technology for cutting concrete for bomb damage repair efforts. Diamond saw blade design parameters (metal bond, diamond type, concentration, and mesh size) were investigated to develop an optimum rapid cutting blade. Blade performance was measured in terms of cutting rate, power requirement and wear performance. Cutting rates as high as 4 sq. ft. min for a 7-inch deep cut were achieved requiring 34 horsepower. At these high cutting rates, the 24-inch diamond saw blades developed gullet cracks. Data from the test program is interpreted regarding the feasibility of several possible diamond saw systems for obtaining cutting rates of 20 sq ft min. Author (GRA)

N83-30441# Sperry Systems Management, Huntsville, Ala.

DESIGN, FABRICATION AND TEST OF AN INTEGRATED BUILT-IN-TEST (BIT) CONTROL UNIT Final Report

T. R. HOOP and E. K. THOMAS Oct. 1982 45 p

(Contract DAAH01-81-D-A012)

(AD-A127278, AD-E950376; DRSMI/RL-CR-83-1) Avail. NTIS HC A03/MF A01 CSCL 14B

This report describes the design of an integrated Built-In-Test (BIT) control unit which may be interfaced with selected missile control subsystems. The control unit design provides the capability to perform tests of the subsystem operational integrity at time of turn-on and continually monitors system operation. In addition, the control unit design provides the capability to perform limited fault diagnosis and isolation to a replaceable assembly. The control unit design provides both a visual display and voice output to alert the operator of a detected malfunction. GRA

N83-30442# Mitre Corp., McLean, Va Metrek Div

SOFTWARE DESCRIPTION FOR THE O'HARE RUNWAY CONFIGURATION MANAGEMENT SYSTEM. VOLUME 1: TECHNICAL DESCRIPTION

S. KAVOUSSI Oct 1982 269 p refs 2 Vol.

(Contract DTFA01-81-C-10003)

(AD-A127398; FAA-EM-82-28-VOL-1, MTR-82W125-VOL-1)

Avail. NTIS HC A12/MF A01 CSCL 01E

This document describes the software developed as part of the Chicago O'Hare Runway Configuration Management System (CMS). The software is designed as an interactive automated

09 RESEARCH AND SUPPORT FACILITIES (AIR)

planning aid to assist the O'Hare assistant chief in the consistent selection of efficient runway configurations in order to lower aircraft delays. In addition, CMS serves as an information management system by consolidating various airport data and making them available for the O'Hare facility personnel. Volume 1 of this document contains the general description of the CMS software plus high level pseudocodes describing its logic. Volume 2 is dedicated to detailed description of the software via low level pseudocodes. Author (GRA)

N83-30443# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.

VELOCITY PERTURBATION OF A FLYER APPROACHING A RIGID IMPERMEABLE BARRIER AND THE TRANSMITTED PRESSURE PULSE

T. O MEYER Mar. 1983 40 p refs

(Contract DE-AC04-76DP-00487)

(DE83-007770; MHSMP-83-10; PDE-101) Avail: NTIS HC

A03/MF A01

The velocity of an electrically-driven Kapton flyer is measured with VISAR as it travels the length of a barrel closed by a clear PMMA window. Velocity perturbation effects (principally that of air compression) are evident. Flyers with a velocity comparable to those viewed through the clear window impact an aluminized window of PMMA. The particle velocity at the interface is measured with VISAR. Good correlation is found for the flyer velocity just after impact from clear PMMA window shots and the peak particle velocity of the aluminized PMMA interface. Current VISAR capabilities at Pantex are discussed. DOE

N83-30774# Wyle Labs., Inc., Colorado Springs, Colo

THE VIBRATION TEST UNIT, A UNIQUE RAIL VEHICLE VIBRATION TEST FACILITY

R O COUPLAND and A J NINTZEL /In Shock and Vibration Information Center The Shock and Vibration Bull., no. 50, part 2 p 217-228 Sep 1980 4 Vol

Avail: NTIS HC A12/MF A01 CSCL 14B

The Vibration Test Unit, a twelve shaker vibration system designed to vibrate a railcar to simulate the action of track/train dynamics is described. It includes a description of the system and a summary of its performance capabilities. Author

N83-31213 Sandia Labs., Albuquerque, N. Mex

FULL-SYSTEM TESTS USING THE SANDIA LIGHTNING SIMULATOR

R A WHITE /In FAA Eighth Intern Aerospace and Ground Conf. on Lightning and Static Elec. 17 p Jun 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Direct-stroke, very high-level natural lightning is simulated with a developmental lightning simulator, which has been used to apply fast-rising, high-current, high-energy outputs to full-scale operational systems. Samples of the wide range in output capabilities of this high-voltage, multiple-pulse simulator are described. Circuit considerations related to its use for testing physically large test items are discussed. The simulator is primarily used for conducting internal Sandia National Laboratories test programs, but example waveforms from direct-stroke lightning simulation tests made for the Navy with functional F-14 and F/A-18 aircraft are also presented. Author

N83-31223 McDonnell Aircraft Co., St. Louis, Mo.

UPDATING THE MCAIR LIGHTNING SIMULATION LABORATORY

E H. SCHULTE /In FAA Eighth Intern Aerospace and Ground Conf. on Lightning and Static Elec. 9 p Jun. 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

The goal of lightning simulation testing of aircraft is to ensure flight safety. The realism of each simulation is limited by the complexities of both the lightning environment and the aircraft itself. As the natural threat becomes better understood and improved test techniques are developed, the modern lightning

laboratory must continually upgrade its equipment and facilities to meet the need for more accurate test simulation. The major test improvements incorporated in the McDonnell Aircraft Company (MCAIR) lightning laboratory are described. Author

N83-31610 Oxford Univ. (England). Dept of Engineering Science.

THE TOPSY GUIDE. TRANSIENT TUNNEL OPERATING, DATA ACQUISITION AND PROCESSING SYSTEM. USER'S AND PROGRAMMER'S GUIDES

N C BAINES Apr 1983 60 p refs

(OUEL-1462/83) Avail: Issuing Activity

TOPSY, a microcomputer operating system for controlling short duration experiments in fluid dynamics is described. TOPSY is not specific to one wind tunnel or one experimental arrangement. The entire system is menu driven for easy use. A modular system divided into separate subroutines and separate programs assures simplicity of modification. TOPSY was implemented on a PDP 11 computer. Author (ESA)

N83-31611# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

DEVELOPMENT OF A CRYOGENIC WINDTUNNEL BALANCE

E GRAEWE 1982 25 p refs Presented at ETW Cryog. Technol. Rev Meeting, Amsterdam, 15-17 Sep. 1982 Sponsored by German Ministry of Research and Technology

(KB-TE-1-1173) Avail: NTIS HC A02/MF A01

The behavior of bending beams from maraging steel equipped with strain gage bridges in the cryo-temperature-range is considered. Development of an unheated six component balance for the use in a cryogenic wind tunnel is considered. Author

N83-31612*# Fluidyne Engineering Corp., Minneapolis, Minn.

PRELIMINARY ENGINEERING STUDY: QUICK OPENING VALVE MSFC HIGH REYNOLDS NUMBER WIND TUNNEL Final Report

Jul 1983 50 p refs

(Contract NAS8-35056)

(NASA-CR-170845, NAS 1 26 170845) Avail: NTIS HC A04/MF A01 CSCL 14B

Fluidyne Engineering Corporation has conducted a preliminary engineering study of a quick-opening valve for the MSFC High Reynolds Number Wind Tunnel under NASA Contract NAS8-35056. The subject valve is intended to replace the Mylar diaphragm system as the flow initiation device for the tunnel. Only valves capable of opening within 0.05 sec and providing a minimum of 11.4 square feet of flow area were considered. Also, the study focused on valves which combined the quick-opening and tight shutoff features in a single unit. A ring sleeve valve concept was chosen for refinement and pricing. Sealing for tight shutoff, ring sleeve closure release and sleeve actuation were considered. The resulting cost estimate includes the valve and requisite modifications to the facility to accommodate the valve as well as the associated design and development work. Author

N83-31613# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept of Civil Engineering.

OPTIMIZATION OF LONG RANGE MAJOR REHABILITATION OF AIRFIELD PAVEMENTS Ph.D. Thesis

D H. ARTMAN, JR Jan 1983 156 p refs

(AD-A127579; AFIT-CI-NR-83-7D) Avail: NTIS HC A08/MF A01 CSCL 01E

The goal of this research has been to develop a methodology for managing pavement networks over prolonged analysis periods. Separate independent methods were devised for project and network level analysis, and the project level procedures were designed to provide inputs into the network level procedures. For the project level analysis, a computer code was written to use dynamic programming methods to optimally select schedule the activities (routine maintenance, reconstruction, and overlays) over the analysis period (20 years), by maximizing the structural performance (area under the utility weighted Pavement Condition Index (PCI) versus time curve). At the network level, the

mathematical representation of choosing those projects that maximize the sum of the user value weighted structural performance of each project, is a zero-one integer linear programming model. Projects are selected using Toyoda's heuristic (each related to a specific feature) that maximizes the objective function with pre-established constraints (network funding limit, etc.). At several funding levels, and a series of management information reports are generated. With these reports, the consequences of selected network funding levels can quantitatively be compared. In addition, an estimate of an appropriate level of funding for the entire system can be made. The simple example shows a substantial difference between a manually developed network program and a program developed with the procedures developed in this research and an application to an existing Air Force base was presented. Author (GRA)

N83-31614# Georgia Inst of Tech, Atlanta School of Civil Engineering

EVALUATION OF DESIGN CRITERION OF THE STRATEGIC EXPEDITIONARY LANDING FIELD M.S. Thesis

R E. BURGOYNE Dec 1982 104 p refs

(Contract N66314-70-A-0067)

(AD-A128323) Avail NTIS HC A06/MF A01 CSCL 14B

This study concerns the relaxation of design criterion for the strategic expeditionary landing field. The design criterion are individually evaluated to determine underlying or governing principles. Each principle is then reviewed to determine the implied or hidden factors of safety. Criteria are then reviewed individually to determine the effects of relaxing that criterion. The evaluation is made to ensure the operational ability of the facility and the construction effort. The construction effort is evaluated for a given circumstance before and after the proposed criterion change. The scope of this work is only that of construction effects and construction effort. The effects on aircraft are not evaluated other than to ensure that the aircraft's performance abilities have not been exceeded. GRA

N83-31615# Veda, Inc., Arlington, Va.

COMPUTER AIDED SYSTEM FOR DEVELOPING AIRCREW TRAINING (CASDAT) Final Report, Sep. 1978 - 15 Jul. 1982

N. C. MARCUE, A. S. BLAIWES, and R. G. BIRD Orlando, Fla Naval Training Equipment Center Mar 1983 208 p refs

(Contract N61339-80-D-0009)

(AD-A128530; NAVTRAEQUIPC-79-C-0076-1;

VEDA-113425-82U/P0707) Avail: NTIS HC A10/MF A01

CSCL 05I

The Naval Training Equipment Center (NAVTRAEQUIPCEN) initiated a research program to investigate automation and other aids as tools to reduce time and personnel requirements of instructional systems development (ISD). This study was conducted in three phases: (1) Determine the theoretical feasibility of using automation to reduce the cost of ISD (2) Demonstrate feasibility by building a prototype aid to ISD (3) Develop the prototype CASDAT into a useful operational system. GRA

N83-31616# General Accounting Office, Washington, D. C. Resources Community Economic Div

POTENTIAL JOINT CIVIL AND MILITARY USE OF MILITARY AIRFIELDS

1 Mar 1983 43 p

(PB83-186734; GAO/RCED-83-98, B-210769) Avail NTIS HC

A03/MF A01 CSCL 01E

GAO's evaluation of joint civilian and military use of military airfields shows the concept to be feasible. Currently, 23 military airfields are operating under joint use agreements. Whether joint use can be expanded to other military airfields depends on overcoming problems unique to each airfield and on the full cooperation of the military and civilian parties involved. Some of the problems are: (1) military concerns about impacts on mission, operations, and/or security; (2) lack of available land to house civilian operations, and (3) lack of support by a civilian sponsor resulting from community opposition or the lack of a real need for joint use of the airfield. GRA

N83-31653# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany)

DEVELOPMENT OF ADVANCED HEATING FACILITY CONCEPTS FOR MICROGRAVITY APPLICATION

J. SCHAWER *In* ESA Mater. Sci under Microgravity p 105-108 Jun 1983

Avail NTIS HC A19/MF A01; ESA, Paris FF 140

Breadboard models of furnaces for microgravity applications, based on electron beam heating and heating by concentric heat pipes were developed. Advantages of an electron beam facility are: electron bombardment is a very efficient source of heat (100 % power utilization); rapid sample heatup, and possibility of operating samples at temperatures 2000 C. The use of heating zone heat pipes gives excellent isothermality within the operational temperature, with isothermality decoupled from heat input. Heat pipe isothermality is not affected by the sample. Steep temperature gradients are possible without overheating the sample. Use of vapor controlled heat pipe cooling zone means that the isothermality of the cooling zone is decoupled from the heat input. Excellent temperature stability even for poor control and for varying heat input and for varying heat sink conditions is achieved. Author (ESA)

N83-31658# Centre National de la Recherche Scientifique, Grenoble (France).

MINIZONE IMAGE FURNACE

R. PERRIERDELABATHIE, J. GOSSET (CNES, Toulouse), J. C. HENNEQUIN (CNES, Toulouse), and F. JAMIN-CHANGEART (CNES, Toulouse) *In* ESA Mater Sci under Microgravity p 133-134 Jun 1983

Avail: NTIS HC A19/MF A01; ESA, Paris FF 140

A laboratory device for melting, using floating zone technology is presented. It uses heat from three 150W halogen lamps focused by ellipsoid mirrors. The lamp holder block is moved by a DC motor and a mechanical reducers assembly with speed variation and control. Maximum diameter of the samples is 5 mm. Melting zone length is 3 to 8 mm. Travel length of the lamp holder is 30 mm. Maximum temperature is 1500 C. Temperature stability is 0.2% for 4hr. Stabilization is achieved in 25 min (1300 C) for material with high thermal conductivity, 10 min with thermal insulating materials. Thermal gradient with good conductivity material is 100 C/cm, with medium conductivity materials is 300 C/cm, and with insulating materials is 500 C/cm. Author (ESA)

N83-31659# Centre National d'Etudes Spatiales, Toulouse (France).

ISOTHERMAL GRADIENT HEAT-PIPES SPACE FURNACE (500 TO 1000 DEG C)

G. CAMBON and F. JAMIN-CHANGEART *In* ESA Mater Sci. under Microgravity p 135-136 Jun. 1983

Avail NTIS HC A19/MF A01; ESA, Paris FF 140

A spaceborne vacuum furnace for investigations of crystal growth and alloy processing is presented. The furnace comprises three isothermal heating zones, each with nine sodium heat pipes (pencil type) inserted in a diffusing block. The experimental area is 22.5 x 375 mm. Absolute temperature accuracy is + or - 2 C. Heat pipe isothermicity is + or - 0.5 C. Temperature constancy is 0.25 C. Thermal gradient is 100 C/cm. Author (ESA)

ASTRONAUTICS

Includes astronautics (general); astrodynamics, ground support systems and facilities (space), launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A83-40885#**COMMUNICATION SATELLITE FOR FUTURE MILITARY AIRCRAFT**

A. K. PADHI (Indian Institute of Technology, Kanpur, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 35, Feb. 1983, p. 33-35

The feasibility of satellite communication for modern military aircraft with speeds ranging from high subsonic to supersonic is discussed. It is pointed out that with X-band microwave transmission, the antenna must have a small beam width and must be kept trained on the satellite during communication. If, however, a frequency in the UHF band is used, a simple, nonsteerable antenna can be used. To provide a global service area, there are in essence two methods of satellite beam format, one using a single global beam and the other using multiple spot beams. A multiple spot beam system complicates the satellite repeater configuration and increases the weight of the satellite antenna subsystem. However, it greatly increases the satellite EIRP and consequently decreases the antenna load in mobile stations (that is, aircraft). A description is then given of a system that provides global coverage with a multiple spot beam C.R.

N83-30360# Air Force Flight Test Center, Edwards AFB, Calif.
PREDICTED AND FLIGHT TEST RESULTS OF THE PERFORMANCE AND STABILITY AND CONTROL OF THE SPACE SHUTTLE FROM REENTRY TO LANDING

P. W. KIRSTEN and D. F. RICHARDSON In AGARD Ground/Flight Test Tech and Correlation 23 p Feb. 1983 refs

Avail: NTIS HC A23/MF A01

Aerodynamic performance and stability data obtained from the first three reentries of the Space Shuttle Orbiter is presented. Flight results are compared to predicted data from Mach 25 to Mach 0.4. Differences between flight and predicted data as well as probable causes for the discrepancies are given. Comparisons between simulator and flight results are also presented Author

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A83-41025**A QUALITY CONTROL TEST TO DETERMINE THE PROPENSITY FOR LUEDERS LINES FORMATION IN 2024-T3**

G. R. CHANANI (Northrop Corp., Aircraft Group, Hawthorne, CA) Journal of Applied Metalworking (ISSN 0162-9700), vol. 3, July 1983, p. 23-31. refs

Lueders lines can appear on the surface during the stretch-forming of aluminum sheets for aircraft skins. These surface strain markings, due to discontinuous plastic deformation, detract from the appearance of the aluminum skins and may be a cause for their rejection. The test method described in this paper was developed to determine whether 2024-T3 sheet material would form Lueders lines during stretch-forming. An increase in the

resolution of the load-deflection curve in the vicinity of the yield point during a tension test performed with pre-determined cross head and chart speeds forms the basis of this test method. This method has been successfully used to predict the forming behavior of many heats, as well as to modify stretch forming parameters for minimizing the problem in forming of transport aircraft skins of 2024-T3 alloy. Author

A83-41199* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FATIGUE CRACK INITIATION AND PROPAGATION IN SEVERAL NICKEL-BASE SUPERALLOYS AT 650 C

J. GAYDA and R. V. MINER (NASA, Lewis Research Center, Materials Div., Cleveland, OH) International Journal of Fatigue (ISSN 0142-1123), vol. 5, July 1983, p. 135-143. refs

The modes of crack initiation and propagation of several nickel-base superalloys have been examined after fatigue and creep-fatigue testing at 650 C. In fatigue, crack initiation was transgranular and frequently associated with porosity or inclusions in the higher strength alloys. These defects were usually located at the surface, except for tests at low strain ranges where larger, internal defects often initiated failure. Although fatigue crack initiation was transgranular, in those alloys with grain sizes of less than 15 microns, fatigue crack growth quickly became intergranular. This transition was environmentally assisted and did not occur for subsurface cracks until the crack broke through to the atmosphere. In the creep-fatigue cycle, which included a 900 s tensile dwell, crack initiation and propagation were both intergranular in all alloys Author

A83-42254* Pratt and Whitney Aircraft, East Hartford, Conn.
RECENT DEVELOPMENTS IN HIGH TEMPERATURE COATINGS FOR GAS TURBINE AIRFOILS

G. W. GOWARD (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT) IN: High temperature corrosion; Proceedings of the International Conference, San Diego, CA, March 2-6, 1981. Houston, TX, National Association of Corrosion Engineers, 1983, p. 553-560. Research supported by the Electric Power Research Institute, U.S. Department of Energy, and NASA. refs

The importance of coatings for hot section airfoils has increased with the drive for more cost-effective use of fuel in a wide variety of gas turbine engines. Minor additions of silicon have been found to appreciably increase the oxidation resistance of plasma-sprayed NiCoCrAlY coatings on a single crystal nickel-base superalloy. Increasing the chromium content of MCrAlY coatings substantially increases the resistance to acidic (Na₂SO₄-SO₃) hot corrosion at temperatures of about 1300 F (704 C) but gives no significant improvement beyond contemporary coatings in the range of 1600 F (871 C). Surface enrichment of MCrAlY coatings with silicon also gives large increases in resistance to acidic hot corrosion in the 1300 F region. The resistance to the thermal stress-induced spalling of zirconia-based thermal barrier coatings has been improved by lowering coating stresses with segmented structures and by controlling the substrate temperature during coating fabrication. C.R.

A83-43316**AVIATION GASOLINE - ISSUES AND ANSWERS**

C. T. ZOOK (FAA, Office of Environment and Energy, Washington, DC) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr 12-15, 1983. 10 p. refs (SAE PAPER 830705)

The lowest grade of aviation gasoline (avgas) currently available for use in reciprocating aircraft engines is grade 80 avgas. The present investigation is concerned with the availability of 80 octane avgas and the possible impact of the elimination of this grade of aviation gasoline on safety. Attention is given to aviation gasoline characteristics, availability and price, accidents related to use of improper grade of fuel (including an employment of jet fuel), and Federal Aviation Administration (FAA) and industry actions in this area. As a result of the decreasing availability of grade 80 avgas, some users are looking for a substitute, taking into account

methanol, ethanol, and other alternative fuels. In the meantime, the use of grade 100LL is the preferable choice, but grade 100 is also an acceptable substitute for grade 80 avgas G R

A83-43752

WEIGHT CONTROL PROGRAM FOR A GRAPHITE/EPOXY AIRCRAFT

J. T. HARGRAVE and D. H. MCCLENAHAN (Lear Fan, Ltd., Reno, NV) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982 12 p (SAWE PAPER 1485)

The benefits of a weight control program for a graphite-epoxy aircraft and problems associated with the design and weight optimization of composite structures are reviewed. It is shown that the use of graphite/epoxy composites can produce aircraft structures that are 10-25 percent lighter than aluminum, the specific strength of a typical composite laminate being 1.5-2.0 times that of aluminum. The design parameters that substantially affect the weight of composite structures are directional properties, bearing strength, notch sensitivity, and environmental factors. Although design criteria for advanced composite structures should be conservative at this time, the underlying weight reduction implications are important. The most efficient structures employ integral design, adhesive bonding, and ply tailoring, a selection of material thicknesses allows laminate optimization. The importance of monitoring the resin content of cured laminates and of minimizing aerial weight tolerance is emphasized. V L

N83-30522*# Avco Corp., Nashville, Tenn

ADVANCED COMPOSITE AILERON FOR L-1011 TRANSPORT AIRCRAFT: AILERON MANUFACTURE Final Report

E. G. DUNNING, W. L. COBBS, and R. L. LEGG Jun 1981 60 p refs

(Contract NAS1-15069)

(NASA-CR-165718, NAS 1.26.165718, AV-R-1147) Avail NTIS HC A04/MF A01 CSCL 11D

The fabrication activities of the Advanced Composite Aileron (ACA) program are discussed. These activities included detail fabrication, manufacturing development, assembly, repair and quality assurance. Five ship sets of ailerons were manufactured. The detail fabrication effort of ribs, spar and covers was accomplished on male tools to a common cure cycle. Graphite epoxy tape and fabric and syntactic epoxy materials were utilized in the fabrication. The ribs and spar were net cured and required no post cure trim. Material inconsistencies resulted in manufacturing development of the front spar during the production effort. The assembly effort was accomplished in subassembly and assembly fixtures. The manual drilling system utilized a dagger type drill in a hydraulic feed control hand drill. Coupon testing for each detail was done. R J F.

N83-30523# Aeronautical Research Labs., Melbourne (Australia)

LECTURES ON COMPOSITE MATERIALS FOR AIRCRAFT STRUCTURES

B. C. HOSKIN, ed and A. A. BAKER, ed Oct 1982 268 p refs Lectures held in Melbourne, Australia, Nov 1981

(ARL-STRUCT-REPT-394; ARL-MAT-REPT-114, AR-002-919)

Avail: NTIS HC A12/MF A01

A broad introduction to the technology of composite materials for aircraft structural applications was presented. Topics covered included the basic theory of fiber reinforcement, material characteristics of the commonly used fiber, resin, and composite systems; component form and manufacture; structural mechanics of composite laminates, joining composites; environmental effects, durability and damage tolerance, repair procedures, aircraft applications; and airworthiness considerations.

N83-30524# Aeronautical Research Labs., Melbourne (Australia)

INTRODUCTION TO LECTURES ON COMPOSITE MATERIALS FOR AIRCRAFT STRUCTURES

B. C. HOSKIN *In its* Lectures on Composite Mater. for Aircraft Struct. p 1-12 Oct 1982 refs

Avail: NTIS HC A12/MF A01

A major development in aeronautics, which came to the fore especially over the past decade or so, was the use of composite materials in place of metals in aircraft structures. In general, a composite material is defined simply as a material which consists of two (or more) identifiably distinct constituent materials. The composite materials used for aircraft structures belong to the class known as fiber composites (or sometimes, fiber reinforced plastics) comprising continuous fibers embedded in a resin (or plastic) matrix. It is the fibers which provide such a composite with its key structural properties, the matrix serving mainly to bond the fiber into a structural entity. The prime reason for using composite materials is that substantial weight savings are achieved because of their superior strength to weight and stiffness to weight ratios, as compared with the conventional materials of aircraft construction such as the aluminum alloys. Weight savings of the order of 25% are generally considered to be achievable using current composites in place of metals. Author

N83-30529# Aeronautical Research Labs., Melbourne (Australia)

COMPONENT FORM AND MANUFACTURE

A. A. BAKER *In its* Lectures on Composite Mater. for Aircraft Struct. p 86-108 Oct 1982 refs

Avail: NTIS HC A12/MF A01

Fiber reinforcement is essentially a one dimensional strengthening process. Since most components are stressed in more than one direction a major function of the forming procedure is to orient the fibers, in the matrix, in the appropriate directions and proportions to obtain the desired mechanical properties. The forming process must also produce the shape of the component and develop the required properties of the matrix. In an ideal fibrous structure the fibers are aligned with the trajectories of principal stress and are concentrated in direct proportion to the local magnitude of the stress. This ideal is approached only by natural materials such as wood and bone. The various manufacturing procedures for fibers reinforced plastics are classified according to the form of the reinforcement. At least in principle, all of the procedures based on continuous fibers (and some of the procedures based on discontinuous fibers) allows close tailoring of mechanical properties. These procedures, particularly those based on laminating, are used for manufacturing aircraft components from glass/epoxy, graphite/epoxy, aramid/epoxy and boron/epoxy. Author

N83-30530# Aeronautical Research Labs., Melbourne (Australia)

STRUCTURAL MECHANICS OF FIBRE COMPOSITES

B. C. HOSKIN and B. I. GREEN *In its* Lectures on Composite Mater. for Aircraft Struct. p 109-133 Oct 1982 refs

Avail: NTIS HC A12/MF A01

The determination of the stresses, strains and deformation in fiber composite structures is outlined. Attention is concentrated on structures made in the form of laminates because that is the way composite materials are generally utilized. From the structural mechanics viewpoint, the novel features of composites, compared with conventional structural materials such as metals, are their marked anisotropy and, when used as laminates, their macroscopically heterogeneous nature. However, it should be remarked that there is one classical structural material, namely wood, which is also both anisotropic and, when used in the form of ply-wood, macroscopically heterogeneous. In fact, much of the theory that is needed in the analysis of composite structures is simply an extension of the theory already used for wooden structures. Author

N83-30531# Aeronautical Research Labs., Melbourne (Australia).

JOINING ADVANCED FIBRE COMPOSITES

A. A. BAKER *In its* Lectures on Composite Mater. for Aircraft Struct. p 134-161 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

Most structures consist of an assembly of a number of individual elements connected to form a load transmission path. These connections or joints are potentially the weakest points in the structure and determine its viability. For example, in aircraft structures, where minimization of weight is important, many of the allowable loads are determined by the strength of the joints. Joining of advanced fiber composites, particularly graphite/epoxy, for aircraft applications where the joints are not subjected to significant bending moments are presented. In general, it is desirable to minimize the number of joints in a structure to minimize both its weight and cost. Fiber composites have an important advantage over metals in this respect, since large one piece components are readily produced. Nevertheless, joints will be required to transmit loads in and out of the composite structure. Usually joints employing metallic members, either aluminium or titanium alloys, are used for this purpose. Author

N83-30532# Aeronautical Research Labs., Melbourne (Australia).

ENVIRONMENTAL EFFECTS AND DURABILITY

B. C. HOSKIN *In its* Lectures on Composite Mater. for Aircraft Struct. p 162-174 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

Key factors which influence the performance of composite aircraft structures in service are discussed. These include environmental effects, especially the effect of moisture absorption from the atmosphere taken in conjunction with elevated temperatures such as are encountered by an aircraft structure in high speed flight, and the effect of cyclic (fatigue) loads. Bearing in mind that metal aircraft structures were in widespread use for almost half a century and that significant uncertainties still exist there in the general areas of environmental effects and fatigue performance, it is hardly considered surprising that significant uncertainties exist in these same areas for composite aircraft structures, where there is so much less experience. Another aspect which compounds the uncertainties for composites is the presence of additional parameters, which have no analog for metals, and which can affect performance, e.g., the ply orientations and stacking sequence for a laminate. It is usual practice, when assessing environmental effects and fatigue performance for design purposes, to establish a relatively large data base for the particular laminate patterns it is intended to employ. Author

N83-30533# Aeronautical Research Labs., Melbourne (Australia).

DAMAGE TOLERANCE OF FIBRE COMPOSITE LAMINATES

M. J. DAVIS and R. JONES *In its* Lectures on Composite Mater. for Aircraft Struct. p 175-199 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

The term damage tolerance is used to describe a design philosophy for military aircraft whereby a component is designed such that structural integrity is maintained while a defect of a given size is present in the structure. Modern military aircraft made of metallic materials are designed on this basis, using fracture mechanics to predict the size of a tolerable flaw under the applied loads. With high performance composites, the field of damage tolerant design is complex, due to the inhomogeneous nature of the material and the failure modes, which differ significantly from those in metals. Composites exhibit near linear stress strain characteristics up to failure, while most metals display some ductile deformation. Thus, composites are less tolerant of overload. In fatigue, composites again differ from metals in that metals are sensitive to tension dominated fatigue loading, whereas composites generally exhibit good resistance to tension fatigue. Composites are, however, susceptible to local delaminations which may grow under compression fatigue. Author

N83-30534# Aeronautical Research Labs., Melbourne (Australia).

NDI OF FIBRE REINFORCED COMPOSITE MATERIALS

I. G. SCOTT and C. M. SCALA *In its* Lectures on Composite Mater. for Aircraft Struct. p 200-216 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

Non-destructive inspection (NDI) of F-R (fiber-reinforced) composite materials is expected to differ from that of metallic materials because composites themselves differ markedly from metals and their alloys. F-R composites are inhomogeneous and markedly anisotropic, they possess a low thermal conductivity along with a high acoustic attenuation, and they are generally poor conductors of electricity. High performance structures are conventionally made from metallic material which is relatively free from unwanted defects; in-service failures tend to originate from crack initiation at identifiable defects and occur after crack propagation. Hence NDI procedures are based on the detection/location of growing cracks, the importance of which is determined using fracture mechanics. No similar predominant failure process was yet identified for composite material, no procedure similar to fracture mechanics was developed and many of the NDI needs are as yet not clearly defined. Author

N83-30535# Aeronautical Research Labs., Melbourne (Australia).

REPAIR OF GRAPHITE/EPOXY COMPOSITES

A. A. BAKER *In its* Lectures on Composite Mater. for Aircraft Struct. p 217-242 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

Graphite/Epoxy composites have many advantages for use as aircraft structural materials, including their high specific strength and stiffness, resistance to damage by fatigue loading and their immunity to corrosion. Thus, extensive use of these composites should reduce the high maintenance costs associated with repair of corrosion damage normally encountered with conventional aluminum alloys, particularly those exposed in a marine environment. Similarly, costs associated with repair of damage due to fatigue should also be substantially reduced, since the composites do not in general suffer from the cracking encountered with metallic structures, particularly cracking resulting from fretting around fastener holes or from corrosion pitting. However, maintenance costs associated with repair of service contact damage is expected to increase, since graphite/epoxy is essentially an unforgiving brittle material - unable to yield plastically under overload. Even quite modest impacts (by metallic standards) can lead to internal damage in the form of delaminations, which may result in a marked strength reduction particularly under compression loading. Author

N83-30536# Aeronautical Research Labs., Melbourne (Australia).

AIRCRAFT APPLICATIONS

B. C. HOSKIN and A. A. BAKER *In its* Lectures on Composite Mater. for Aircraft Struct. p 243-252 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

As already described in the first lecture, composite materials, especially graphite/epoxy, are being used to a significant extent in present day aircraft and all the signs are that this use will increase. The nature of some of these applications is discussed further and an indication given of what seem to be the general design rules that are evolving. Also, some matters that need special attention for composite structure (such as lightning protection and erosion protection) are touched on. Brief mention is made of composite applications in helicopter construction. Author

N83-30537# Aeronautical Research Labs., Melbourne (Australia).

AIRWORTHINESS CONSIDERATIONS

B. C. HOSKIN *In its* Lectures on Composite Mater. for Aircraft Struct. p 253-262 Oct. 1982 refs
 Avail: NTIS HC A12/MF A01

The use of composite materials raises some problems which are different to those for metal aircraft structures. These problems,

in turn, raise questions about specific airworthiness requirements for composite aircraft structures. At this state, few such formal specific requirements exist. As an example, consider the matter of the effect of the moisture/temperature environment on structural performance. Although the US Military Standard on Aircraft Structural Integrity states that the standard applies to metallic and non-metallic structures, and although the US Military Handbook details general design procedures for composite structures, neither document specifies a procedure for allowing for environmental effects in the structural integrity program, including the static and fatigue tests on full scale articles. Airworthiness requirements for UK military aircraft containing composite structure only exist in draft form. Author

N83-30539*# Rockwell International Corp., Downey, Calif
GRAPHITE/LARC-160 TECHNOLOGY DEMONSTRATION SEGMENT TEST RESULTS

W H MORITA and S R. GRAVES Jun. 1983 124 p refs
 (Contract NAS1-15371)
 (NASA-CR-172123, NAS 1.26 172123) Avail NTIS HC A06/MF A01 CSCL 11D

A structural test program was conducted on a Celion/LARC-160 graphite/polyimide technology demonstration segment (TDS) to verify the technology. The 137 x 152 cm (54 x 60 in) TDS simulates a full-scale section of the orbiter composite body flap design incorporating three ribs and extending from the forward cove back to the rear spar. The TDS was successfully subjected to mechanical loads and thermal environments (-170 to 316 C) simulating 100 shuttle orbiter missions. Successful completion of the test program verified the design, analysis, and fabrication methodology for bonded Gr/PI honeycomb sandwich structure and demonstration that Gr/PI composite technology readiness is established. MG

N83-30548*# Argonne National Lab., Ill
EXPERIMENTAL GAS-FIRED PULSE-COMBUSTION STUDIES
 C A BLOMQUIST Sep. 1982 313 p refs Sponsored by NASA

(Contract W-31-109-ENG-38)
 (NASA-CR-172827; NAS 1.26 172827, DE83-009753;
 ANL/EES-TM-214) Avail NTIS HC A14/MF A01 CSCL 07D

Experimental studies conducted at Argonne National Laboratory on a gas-fired, water-cooled, Helmholtz-type pulse combustion burner are discussed. In addition to the experimental work, information is presented on the evolution of pulse combustion, the types of pulse combustion burners and their applications, and the types of fuels used. Also included is a survey of other pertinent studies of gas-fired pulse combustion. The burner used in the Argonne research effort was equipped with adjustable air and gas flapper valves and was operated stably over a heat-input range of 30,000 to 200,000 Btu/h. The burner's overall heat transfer in the pulsating mode was 22 to 31% higher than when the unit was operated in the steady mode. Important phenomena discussed include (1) effects on performance produced by inserting a coreburner to change tailpipe diameter, (2) effects observed following addition of an air-inlet decoupling chamber to the unit, and (3) occurrence of carbon monoxide in the exhaust gas

DOE

N83-30551*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Engineering
BROAD SPECIFICATION FUELS TECHNOLOGY PROGRAM, PHASE 1 Final Report

R. P LOHMANN and R. A. JEROSZKO 11 Oct 1982 210 p refs
 (Contract NAS3-22392)
 (NASA-CR-168180, NAS 1.26 168180, PWA-5719-34) Avail:
 NTIS HC A10/MF A01 CSCL 21B

An experimental evaluation was conducted to assess the impact of the use of broadened properties fuels on combustor design concepts. Emphasis was placed on establishing the viability of design modifications to current combustor concepts and the use of advanced technology concepts to facilitate operation on Experimental Referee Broad Specification (ERBS) fuel while

meeting exhaust emissions and performance specifications and maintaining acceptable durability. Three different combustor concepts, representative of progressively more aggressive technology levels, were evaluated. When operated on ERBS rather than Jet A fuel, a single stage combustor typical of that in the most recent versions of the JT9D-7 engine was found to produce excess carbon monoxide emissions at idle and elevated liner temperatures at high power levels that were projected to reduced liner life by 13 percent. The introduction of improved component technology, such as refined fuel injectors and advanced liner cooling concepts were shown to have the potential of enhancing the fuel flexibility of the single stage combustor. Author

N83-30555# Naval Postgraduate School, Monterey, Calif Dept. of Aeronautics.

AN EXPERIMENTAL INVESTIGATION OF THE COMBUSTION BEHAVIOR OF SOLID FUEL RAMJETS M.S. Thesis

G A BEGLEY, JR. Dec. 1982 34 p refs
 (AD-A127165) Avail: NTIS HC A03/MF A01 CSCL 21B

Limited experimental data indicated that fuel vapor composition within the SFRJ combustor may have a significant effect on the obtainable combustion efficiency and upon the dependence of combustion efficiency upon equivalence ratio and air mass flow rate. Combustor pressure oscillations in bypass operation were found to increase regression rates when using PMM fuel grains and to increase or decrease combustion efficiency depending upon equivalence ratio GRA

N83-30662*# Ford Motor Co., Dearborn, Mich Research Staff
EVALUATION OF CERAMICS FOR STATOR APPLICATIONS: GAS TURBINE ENGINES INTERIM REPORT. STATOR FABRICATION AND EVALUATION Final Report

N. ARNON and W. TRELA Mar. 1983 67 p refs
 (Contract DEN3-0019)
 (NASA-CR-168140; DOE/NASA/0019-83/1, NAS 1 26 168140)
 Avail NTIS HC A04/MF A01 CSCL 11B

The objective was to assess current ceramic materials, fabrication processes, reliability prediction, and stator durability when subjected to simulated automotive gas turbine engine operating conditions. Ceramic one-piece stators were fabricated of two materials, silicon nitride and silicon carbide, using two near-net-shape processes, slip casting and injection molding. Non-destructive evaluation tests were conducted on all stators identifying irregularities which could contribute to failures under durability testing. Development of the test rig and automatic control system for repeatably controlling air flow rate and temperature over a highly transient durability duty cycle is discussed. Durability results are presented for repeated thermal cycle testing of the ceramic one-piece stators. Two duty cycles were used, encompassing the temperature ranges of 704 to 1204 C (1300 to 2200 F) and 871 to 1371 C (1600 to 2500 F). Tests were conducted on 28 stators, accumulating 135,551 cycles in 2441 hours of hot testing. Cyclic durability for the ceramic one-piece stator was demonstrated to be in excess of 500 hours, accumulating over 28,850 thermal cycles. Ceramic interface forces were found to be the significant factor in limiting stator life rather than the scatter in material strength properties or the variation in component defects encountered R.J.F.

N83-30673# Army Aviation Engineering Flight Activity, Edwards AFB, Calif Directorate for Development and Qualification.

FUEL CONSERVATION EVALUATION OF U.S. (UNITED STATES) ARMY HELICOPTERS. PART 4: OH-58C FLIGHT TESTING Final Report, 22 Sep. - 20 Nov. 1982

D BELTE and M V STRATTON Aug. 1982 82 p refs
 (AD-A127422; USAAFEFA-81-01-4) Avail: NTIS HC A05/MF A01 CSCL 21D

The United States Army Aviation Engineering Flight Activity conducted level flight performance tests of the OH-58C helicopter at Edwards AFB, California from 22 September to 20 November 1981, and at St Paul, Minnesota, from 12 January to 9 February 1982. Nondimensional methods were used to identify effects of compressibility and blade stall on performance, and increased

referred rotor speeds were used to supplement the range of currently available level flight data. Maximum differences in nondimensional power required attributed to compressibility effects varied from 6.5 to 11%. However, high actual rotor speed at a given condition can result in less power required than at low rotor speed even with the compressibility penalty. The power required characteristics determined by these tests can be combined with engine performance to determine the most fuel efficient operating conditions. GRA

N83-30678# Deutsche Shell A G , Hamburg (West Germany)
SHELL BRIEFING SERVICE: AIRCRAFT FUELS TODAY AND TOMORROW [SHELL BRIEFING SERVICE: FLUGKRAFTSTOFFE HEUTE UND MORGEN]
 Nov. 1982 12 p refs In GERMAN
 Avail: NTIS HC A02/MF A01

The worldwide increase of the demand for mineral oil products and the possible supply problem at the end of the eighties are reviewed. Author (ESA)

N83-31729 British Aerospace Aircraft Group, Kingston-upon-Thames (England). Ground Test Services Dept.
COMPOSITES IN GROUND TEST SERVICES
 G. W. J. CLAPP Dec 1982 10 p refs
 (BAE-KGT-N-GEN-00999) Avail Issuing Activity

An outline of the requirements of a ground technical service to support carbon fiber composite testing is presented. The areas of interest are the investigation of failures in structural coupons and test specimens, the design of coupon test specimens and the information research concerning the conditions that the structures are likely to experience in service. A block diagram showing the interrelationships of type of study with manufacturing and quality testing programs summarizes the discussion.

Author (ESA)

N83-31730*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
STANDARD TESTS FOR TOUGHENED RESIN COMPOSITES, REVISED EDITION
 Jul. 1983 38 p refs
 (NASA-RP-1092-REV, L-15317A; NAS 1.61 1092-REV) Avail.
 NTIS HC A03/MF A01 CSCL 11D

Several toughened resin systems are evaluated to achieve commonality for certain kinds of tests used to characterize toughened resin composites. Specifications for five tests were standardized, these test standards are described. Author

N83-31734# Air Force Inst of Tech., Wright-Patterson AFB, Ohio.
AEROELASTIC PROPERTIES OF STRAIGHT AND FORWARD SWEEP GRAPHITE/EPOXY WINGS M.S. Thesis
 B. J. LANDSBERGER Feb 1983 159 p
 (AD-A127014; AFIT-CI-NR-83-11T) Avail NTIS HC A08/MF A01 CSCL 20D

The aeroelastic deformation, divergence and flutter behavior of rectangular, graphite/epoxy, cantilevered plate type wings at zero sweep and thirty degrees of forward sweep is investigated for incompressible flow. Since the wings have varying amounts of bending stiffness, torsion stiffness and bending-torsion stiffness coupling, they each have unique aeroelastic properties. A five mode Rayleigh-Ritz formulation is used to calculate the equation of motion. From this equation static deflection, steady airload deflection, divergence velocities, natural frequencies and flutter velocities are calculated. Experimental two dimensional lift and drag curve data and approximations to three dimensional aerodynamics are used to calculate the aerodynamic forces for the steady airload analysis. The Weissinger L-Method for three dimensional aerodynamic forces is used in the divergence analysis. The V-g method is used to make flutter and natural frequency calculations. Tests on a static loading apparatus gave static deflections, while wind tunnel tests gave steady airload deflections for the wings at zero sweep, and divergence and flutter behavior

data for all wings at both zero sweep and thirty degrees forward sweep GRA

N83-31735# Massachusetts Inst of Tech, Cambridge Dept. of Aeronautics and Astronautics
DESIGN TECHNOLOGY OF ADVANCED COMPOSITES Final Report, Apr. 1977 - May 1982
 J W MAR and P A. LAGACE Nov. 1982 66 p refs
 (Contract F33615-77-C-5155, AF PROJ. ILIR)
 (AD-A127892, AFWAL-TR-82-4178) Avail: NTIS HC A04/MF A01 CSCL 11D

The results of several investigations dealing with the design technology of advanced composites are reported. Experimental work was conducted on Hercules graphite/epoxy prepreg in two forms: AS1/3501-6 unidirectional tape and A370-5H/3501-6 fabric. The investigations examine damage tolerance of cylinders, shear buckling, unsymmetric laminates, aeroelastic behavior, and several other topics. In addition, the major accomplishments and benefit of this five year program are highlighted. Author (GRA)

N83-31752# Dayton Univ, Ohio. Research Inst.
SPECTROMETER SENSITIVITY INVESTIGATIONS ON THE SPECTROMETRIC OIL ANALYSIS PROGRAM Final Report, 28 Aug. 1981 - 28 Aug. 1982
 W E. RHINE, C. S. SABA, and R E. KAUFFMAN 22 Apr. 1983 180 p refs
 (Contract N68335-81-C-4587; WF41460000)
 (AD-A127969; NAEC-92-169) Avail: NTIS HC A09/MF A01 CSCL 01C

An investigation was conducted in order to determine the particle detection capabilities of the A/E35U-3 rotating disk electrode arc/spark emission spectrometer used by the Joint Oil Analysis Program. It was found that the analyses determined with the rotating disk electrode (RDE) spectrometer were particle-size dependent and that the RDE spectrometer cannot quantitatively analyze particles larger than 5-10 micrometers. The reasons for the low particle detection capabilities were examined and found to be related to particle settling rates which limit the rotating disk's capability to transport particles to the source. Particle transport is improved by using viscous matrices, but the source does not possess the energy required to simultaneously vaporize the oil and excite the metal particles present. Therefore, the particle detection capability of the RDE spectrometer is limited by the low particle transport efficiency of its rotating disk and the low energy of its source. In order to improve the particle detection capabilities of the RDE spectrometer, several alternative sample introduction methods were investigated. Of the methods investigated, the ashing techniques offer the most promise for improving the particle detection capabilities of the RDE spectrometer. Author (GRA)

N83-31795* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SILICON-SLURRY/ALUMINIDE COATING Patent
 D. L. DEADMORE and S. G. YOUNG, inventors (to NASA) 15 Feb. 1983 6 p Filed 14 Aug. 1981
 (NASA-CASE-13343-2, US-PATENT-4,374,183, US-PATENT-APPL-SN-293418, US-PATENT-CLASS-428-641, US-PATENT-CLASS-428-650, US-PATENT-CLASS-428-680, US-PATENT-CLASS-428-450; US-PATENT-CLASS-428-469; US-PATENT-CLASS-427-318, US-PATENT-CLASS-427-419.2)
 Avail US Patent and Trademark Office CSCL 11F

A low cost coating protects metallic base system substrates from high temperatures, high gas velocity oxidation, thermal fatigue and hot corrosion and is particularly useful for protecting vanes and blades in aircraft and land based gas turbine engines. A lacquer slurry comprising cellulose nitrate containing high purity silicon powder is sprayed onto the superalloy substrates. The silicon layer is then aluminized to complete the coating. The Si-Al coating is less costly to produce than advanced aluminides and protects the substrates from oxidation and thermal fatigue for a much longer period of time than the conventional aluminide coatings. While more expensive Pt-Al coatings and physical vapor deposited MCrAlY coatings may last longer or provide equal protection on

certain substrates, the Si-Al coating exceeded the performance of both types of coatings on certain superalloys in high gas velocity oxidation and thermal fatigue and increased the resistance of certain superalloys to hot corrosion

Official Gazette of the U.S. Patent and Trademark Office

N83-31824# Avco Lycoming Div., Stratford, Conn
INTEGRALLY CAST LOW-COST COMPRESSOR Final Technical Report, 26 May 1978 - 25 Mar. 1982

B. H. HESSLER, M. S. MUNTNER, D. CARGO, and B. ROOPCHAND Warren, Mich. TACOM 3 Jan 1983 134 p refs

(Contract DAAK30-78-C-0039; MM&T PROJ T785097)
 (AD-A127663, TACOM-TR-12673) Avail NTIS HC A07/MF A01 CSCL 11F

The low pressure compressor stages of the AGT-1500 engine are designed as separately bladed assemblies requiring extensive precision machining and grinding. Cost savings could be achieved if the compressor stages were integrally cast in order to eliminate many machining operations. The casting of precision parts involving very thin leading and trailing edges was achieved in a multi-phased effort; acceptable product yields were achieved with the first and second stage wheels and not with the fifth stage. A follow-on effort will be required in order to support implementation of program results

GRA

12

ENGINEERING

Includes engineering (general); communications, electronics and electrical engineering; fluid mechanics and heat transfer, instrumentation and photography, lasers and masers, mechanical engineering; quality assurance and reliability, and structural mechanics.

A83-40675
AEROELASTIC OPTIMIZATION OF ORTHOTROPIC RECTANGULAR FLAT PANELS

L. LIBRESCU (Tel Aviv University, Tel Aviv, Israel) and L. BEINER (Negev, University, Beersheba, Israel) Optimal Control Applications and Methods (ISSN 0143-2087), vol. 4, Apr-June 1983, p. 193-198. refs

The paper deals with a weight-minimization problem of rectangular orthotropic flat panels placed in a high supersonic gas flow and subject to a flutter speed constraint. In-plane compressive loads are taken into account. The problem is treated in the framework of the optimal control theory of distributed parameter systems. It is shown that the necessary optimality conditions are to be supplemented with a condition ensuring that the flutter speed of the optimal panel should coincide with the prescribed one. The general field equations governing the aeroelastic optimization problem are presented, and qualitative conclusions concerning the optimal thickness distribution are given. A few remarks on various methods for solving the field equations are also given.

Author

A83-40757
LOW-SIDELobe RADAR ANTENNAS

G. E. EVANS and H. E. SCHRANK (Westinghouse Defense and Electronics Center, Baltimore, MD) Microwave Journal (ISSN 0026-2897), vol. 26, July 1983, p. 109, 110, 112 (5 ff.) refs

The advances that made sidelobes of -50 dB possible are recounted, and the factors determining whether the sidelobes can be carried into wider bandwidths are discussed. Attention is also given to the use of sidelobes in agile and active arrays. That slotted arrays were the first to achieve ultra-low sidelobes is not considered an accident. Each point in the distribution is determined individually by slot location and shape, and these can be readily milled with exactness. Also described are corporate-fed planar

arrays, reflectors and lenses, and conformal arrays. In discussing tolerance and bandwidth, it is pointed out that for any antenna the key to achieving low sidelobes is to recognize and control the sources of error that degrade sidelobe levels. In general, the error sources are in the structure, mutual coupling, component manufacturing tolerance, and frequency response, and they give rise to errors of three types: gradual distortion, random errors, and systematic errors. Each of these is discussed.

C.R.

A83-40758
POLARIMETRIC TECHNIQUES IN RADAR SIGNAL PROCESSING

S. R. CLOUDE (Royal Signals and Radar Establishment, Airborne Radar Div., Malvern, Worcs., England) Microwave Journal (ISSN 0026-2897), vol. 26, July 1983, p. 119, 120, 122 (5 ff.) refs

A canonical approach to the inclusion of polarization phenomena in radar is outlined. The techniques are considered important because in the past many questions have been raised over the relevance of polarization phenomena to radar system optimization. It is pointed out that only by investigating the problem from a fundamental viewpoint will the potential of these techniques be realized. The concepts outlined here provide the basis of such an investigation. The inclusion of polarization phenomena in radars is seen as an important step toward full vector processing. Systems may thus be designed to use the available information in an optimal manner, combining perhaps polarization with broadband techniques for enhanced system performance.

C.R.

A83-40873*# National Aeronautics and Space Administration.
 Langley Research Center, Hampton, Va.

THE DYNAMIC COLLAPSE OF A COLUMN IMPACTING A RIGID SURFACE

J. M. HOUSNER and N. F. KNIGHT, JR. (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers, Part 2, p. 530-541) AIAA Journal (ISSN 0001-1452), vol. 21, Aug. 1983, p. 1187-1195 refs

Previously cited in issue 13, p. 2112, Accession no. A82-30182

A83-41026
DESIGN OF ALGORITHMS TO EXTRACT DATA FROM CAPACITANCE SENSORS TO MEASURE FASTENER HOLE PROFILES

J. L. HAMMOND, JR. (Georgia Institute of Technology, Atlanta, GA) and S. R. GLIDEWELL (Lockheed-Georgia Co., Marietta, GA) IEEE Transactions on Instrumentation and Measurement (ISSN 0018-9456), vol. IM-32, June 1983, p. 343-349. Research sponsored by the Lockheed-Georgia Co. and U.S. Air Force. refs

This paper discusses algorithms used to process data from a multisegmented capacitance probe as the basis for a system for nondestructive testing of aircraft fastener holes. Measurement accuracies on the order of tenths of mils are achieved through a combination of accurate electronic measurement of capacity and use of the computer-implemented algorithms for estimating hole profiles. The estimation algorithms make possible the novel feature of allowing accurate determination of hole profiles for arbitrary positioning of the probe in the hole. The paper gives a brief description of the measurement system and the capacitance probe. The algorithms are discussed in detail and examples of measured profiles for known hole shapes are given.

Author

A83-41048*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va

TRANSONIC FLUTTER MODEL STUDY OF A SUPERCRITICAL WING AND WINGLET

C. L. RUHLIN (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA), F. J. RAUCH, JR., and C. WATERS (Grumman Aerospace Corp., Bethpage, NY) (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers, Part 2, p 407-415) Journal of Aircraft (ISSN 0021-8669), vol 20, Aug. 1983, p. 711-716. refs

Previously cited in issue 13, p. 2111, Accession no. A82-30171

A83-41075

ASSESSMENT OF ROTOR-FUSELAGE COUPLING ON VIBRATION PREDICTIONS USING A SIMPLE FINITE ELEMENT MODEL

M. J. RUTKOWSKI (U.S. Army, Army Research and Technology Laboratories, Moffett Field, CA) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, July 1983, p. 20-25 refs

The effect of rotor/fuselage coupling on vibration predictions is investigated using a simplified structural model of a helicopter in hover. The analysis model is based on a two degree-of-freedom beam finite element with polynomial mass and stiffness distributions and includes mass, aerodynamic damping, and elastic and centrifugal stiffness matrices. Complex eigenanalyses are carried out for a coupled rotor-fuselage system to obtain symmetric fuselage and collective blade modes as a function of rotor speed. Vibration response results are obtained for the coupled system subjected to a radially uniform, harmonic blade loading. The coupled response results are compared with response results from an uncoupled analysis in which hub loads for an isolated rotor system subjected to the same sinusoidal blade loading as the coupled system are applied to a free-free fuselage. It is shown that although the character of the fuselage response as a function of forcing frequency and rotor speed is similar in the two cases, the responses resulting from the approximate, uncoupled analysis are significantly greater than those resulting from the coupled analysis. Thus, it is necessary to carry out a coupled rotor-fuselage analysis in order to accurately predict the fuselage vibration response. Author

A83-41703*# Integrated Systems, Inc., Palo Alto, Calif

ALGORITHMS FOR REAL-TIME FLUTTER IDENTIFICATION

R. A. WALKER, N. K. GUPTA (Integrated Systems, Inc., Palo Alto, CA), and G. B. GILYARD (NASA, Flight Research Center, Edwards, CA) IN Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p 432-440 refs (AIAA PAPER 83-2223)

The work reported here addresses the important algorithm issues necessary to achieve a real-time flutter monitoring system, namely, the guidelines for choosing appropriate model forms, reduction of the parameter convergence transient, handling multiple modes, the effect of overparameterization, and estimate accuracy predictions, both online and for experiment design. An approach for efficiently computing continuous-time flutter parameter Cramer-Rao estimate error bounds has been developed. This enables a convincing comparison of theoretical and simulation results, as well as off-line studies in preparation for a flight test. Theoretical predictions, simulation and flight test results from the NASA/Dryden Drones for Aerodynamic and Structural Test (DAST) Program are compared. Author

A83-41891

THE MEASUREMENT OF PRESSURE PULSATIONS BY MEANS OF PIEZOELECTRIC TRANSDUCERS [OB IZMERENII PUL'SATSII DAVLENIIA P'EZOELEKTRICHESKIMI PREOBRAZOVATELIAMI]

V. M. MEDVEDEV, O. V. SHAKOTKO, and A. I. TSVETKOV (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) IN: The motion of compressible fluids and inhomogeneous media. Leningrad, Izdatel'stvo Leningradskogo Universiteta, 1982, p 130-135. In Russian

The paper describes piezoelectric instrumentation which has been developed to measure pressure pulsations and the amplitudes of the spectral components of pressure pulsations. The instrumentation has been developed in the general framework of the investigation of the interaction of gas jets and resonance tubes. Particular consideration is given to the design of the transducer, the matching-amplifier circuit, transistor design, the response of the device to a calibrating rectangular signal and pulsed pressure, and the recording equipment. It is noted that this instrumentation can be used to measure pressure pulsations in internal combustion engines and jet engines. B.J

A83-41983

A SEPARATOR FOR OBTAINING SAMPLES OF CLOUD WATER IN AIRCRAFT

P. T. WALTERS, M. J. MOORE, and A. H. WEBB (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England) Atmospheric Environment (ISSN 0004-6981), vol. 17, no. 6, 1983, p. 1083-1091. refs

In order to study the effect of SO₂ emissions from power stations on the formation of acid rain, cloud water sampled in the presence of the effluent gases is required for analysis. A small axial flow cyclone is described for separating the liquid water from cloud sampled by aircraft to provide these samples. The description covers structural aspects, the installation in the aircraft and a theoretical prediction of its service performance. It is shown that the separator will remove all droplets of greater than 5-micron diameter under the action only of the ram pressure generated by the forward speed of the aircraft. The optimization of the design in a simple ground based cloud tunnel is then described, and test results are given which indicate that adequate cloud water samples for chemical analyses should be obtained when the liquid water content of the sampled cloud exceeds 0.35 g/cu m. This is supported by the results of early flight tests, and it is concluded that the separator will provide useful cloud water samples in most homogeneous cloud conditions. Author

A83-42144

AN EXPERIMENTAL STUDY OF BALL BEARINGS IN THE COMBINED SUPPORTS OF THE ROTORS OF GAS-TURBINE ENGINES [K EKSPERIMENTAL'NOMU ISSLEDOVANIIU SHARIKOPODSHIPNIKOV V KOMBINIROVANNOM OPORE ROTOROV GTD]

L. V. GORIUNOV, V. M. DEMIDOVICH, A. P. KLIUSHKIN, and N. A. IAKIMOV (Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1983, p 82-84. In Russian.

The use of combined supports consisting of a ball bearing and a conical hydrostatic bearing makes it possible to substantially increase the service life of the ball bearing. In a combined support, the inner race of the ball bearing rotates at a third of the shaft speed, resulting in reduced centrifugal forces and lower temperatures. An experimental stand is described which makes it possible to study the thermal regimes of combined supports with ball bearings of various sizes over a wide range of axial loads (0-50,000 N), speeds (up to 15,000 rpm), and oil temperatures (30-80 C). V.L

A83-42334**NUMERICAL ANALYSIS OF NATURAL, COUPLED, LONGITUDINAL-LATERAL VIBRATIONS OF AN ASYMMETRIC AEROPLANE**

Z. DZYGADLO and J. BLASZCZYK *Journal of Technical Physics* (ISSN 0324-8313), vol. 23, no. 2, 1982, p. 119-139. refs

The aircraft treated has an asymmetric mass distribution. It is assumed that the center of mass of the front, rigid part of the fuselage is displaced laterally. As a consequence of this asymmetry, the longitudinal (symmetric) and lateral (asymmetric) vibrations of the system are coupled. Attention is thus given to the natural coupled longitudinal-lateral vibrations of the structure. Equations of dynamic equilibrium of deformable units of the aircraft are established, together with the equations of motion of the rigid parts of the fuselage; these constitute the dynamic conditions of coupling between the equations of the deformable units. Allowing for the compatibility conditions of translation and rotation of the rigid and deformable parts of the aircraft and for the free and fixed boundary conditions, a final set of relations is obtained. These relations make it possible to determine the natural frequencies and modes of longitudinal-lateral vibrations of the system. An algorithm and an ALGOL program are then written, and a computation is made for a hypothetical aircraft having a uniform mass and rigidity distribution along the deformable units. The results are compared with those obtained by Dzygadło and Błaszczyk (1978, 1980). C.R.

A83-42540#**RESIDUAL STRENGTH PREDICTIONS FOR BALLISTICALLY DAMAGED AIRCRAFT**

G. J. CZARNECKI (USAF, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 5-2-1 to 5-2-3

In an effort to predict the load carrying capability of ballistically damaged aircraft wings, three MAGNA finite element models have been developed. Wings modeled were the F-4B, and F-15. An A-7 composite wing model is presently under construction. To validate computer predictions, each of the four wings were loaded and ballistically damaged with a high explosive incendiary (HEI) round. Strain gage and deflection data were recorded in the pre- and post-damage conditions. Ultimately, efforts will concentrate toward utilizing this computer code (or a derivation) as a structural design tool which takes survivability/vulnerability aspects into account. Author

A83-42541#**FLUTTER INVESTIGATION OF A REPAIRED T-38 HORIZONTAL STABILIZER USING NASTRAN**

H. C. BRIGGS (USAF, Institute of Technology, Wright-Patterson AFB, OH) and G. G. LONDON IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 5-3-1 to 5-3-5. refs

The procedure for evaluating the effect of repairs on the stabilizer flutter speed is developed and the flutter speed sensitivity to several modeling assumptions and practices are presented. The NASTRAN flutter speed calculations are based upon a structural model, an unsteady aerodynamic model, and an interface model of splines. Depending on the aerodynamic theory used, doublet lattice method, strip theory or Mach box method, the aerodynamic and interface models must be changed. The results show that the current repair limitations have little or no effect on the flutter speed. The predicted flutter speeds differ depending on the aerodynamic theory used. Author

A83-42542#**FINITE ELEMENT MODEL TUNING VIA MULTIPLE OBJECTIVE OPTIMIZATION TECHNIQUES**

H. C. BRIGGS and A. R. DEWISPELARE (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 5-6-1 to 5-6-4. refs

A procedure based on multiple objective optimization techniques that automates and clarifies the problem of correcting a finite element model has been constructed and implemented. The advantage of the method lies in its separation of the problem into two parts: the generation of the solution set, which is largely based on engineering modeling and computational techniques, is easily automated and need be accomplished only once, and the ordering of the solution set, which is based on value judgments concerning the worth of individual performance measures, involves little computation and is readily reaccomplished when new preferences arise. The application of the procedure to a structural model to be used to evaluate the effect of horizontal stabilizer repairs on static stresses and the aircraft flutter speed is described. C.D.

A83-42544#**UNDETECTABLE CRITICAL DEFECTS IN SAFETY-OF-FLIGHT STRUCTURE**

J. W. GOODMAN and W. L. TORREY (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 6-5-1 to 6-5-5. refs

Damage tolerance of safety-of-flight aircraft structure is discussed, emphasizing the role of undetectable defects and procedures to minimize their potential threat. Examples of the reliability and durability exhibited by bonded and composite parts in service are described, and some rare processing errors which have occurred are discussed, including poorly prepared metal surfaces, nonbonding films in composite laminates, and surface contamination by a liquid. Approaches to product assurance are considered, such as improved inspectability, direct strength assurance, and fail-safe design. C.D.

A83-42559#**TAPERED ROLLER BEARINGS FOR TURBINE ENGINES**

D. S. KORETSKY (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 13-2-1, 13-2-2.

Recent advances in high-speed tapered roller bearing technology conclusively show potential for these bearings to be used for mainshaft support in advanced gas turbine engines. Testing demonstrated safe operation of tapered bearings at speeds up to 3.5 million DN. On-going bearing tests are simulating an actual turbine environment, an advanced turbine engine gas generator. The test results indicate high speed tapered roller bearings can carry high thrust loads (20,000 lbs) and operate at turbine engine speeds (15,000 rpm). Author

A83-42564#**FLOW VISUALIZATION INVESTIGATION OF CHOKING CASCADE TURNS**

W. C. ELROD (USAF, Institute of Technology, Wright-Patterson AFB, OH), D. B. WILKINSON (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), and J. BAIRD IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 13-8-1 to 13-8-7. refs

Ramjet engines use an aerodynamic grid upstream of the combustor to prevent adverse flow conditions at the combustor entrance during super-critical inlet operation. An investigation was

made of the feasibility of applying the aerodynamic grid in a short radius turn to reduce the inlet length for applications where the centerline of the inlet is offset from or inclined to the axis of the combustion. Flow visualization techniques were used with a water table for simulating the two-dimensional gasdynamic inlet flow. The results obtained for various aerodynamic grid configurations in a 90 degree turn will be presented. Author

A83-42618**UNIVERSITIES - HAVE THEY A ROLE IN AERONAUTICAL RESEARCH? STRUCTURES AND MATERIALS**

G. A. O. DAVIES (Imperial College of Science and Technology, London, England) Aeronautical Journal (ISSN 0001-9240), vol. 87, June-July 1983, p. 219-223 refs

Universities can take a risk and embark on a novel idea which may prove to be invalid. They can provide preliminary answers to pressing problems from industry and then examine the problem in greater depth. Research in the following fields is surveyed: finite elements, buckling and fracture, fiber composite structures, and metallic materials. While university research is fundamental, it is also applicable. It is pointed out that today it must be applicable because if the research is not sponsored, universities cannot afford to undertake it. C.R.

A83-42659**ENHANCEMENT OF HEAT TRANSFER**

W. NAKAYAMA (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Ibaraki, Japan) IN: Heat transfer 1982, Proceedings of the Seventh International Conference, Munich, West Germany, September 6-10, 1982. Volume 1. Washington, DC, Hemisphere Publishing Corp., 1982, p. 223-240 refs

Recent publications on enhancement of heat transfer are reviewed, emphasizing the effects of roughness elements, fins, and porous surfaces. Enhancement of forced convective heat transfer on roughened surfaces, performance evaluation of enhanced surfaces, viscous flows in cooled tubes and tubes with swirlers, and active methods of enhancement are addressed. Aspects of pool boiling heat transfer are considered, including nucleate boiling heat transfer on rough surfaces and porous surfaces, and maximum and minimum heat fluxes. Evaporative heat transfer is discussed for thin-film evaporation on structured surfaces and liquid spray cooling of a heated surface. Condensation heat transfer on external surfaces is covered, including filmwise condensation on vertical finned and fluted surfaces and on horizontal tubes. In-tube boiling and condensation are treated, discussing their enhancement by fins and inserts, as well as critical heat flux in coiled, rifled, and corrugated tubes. C.D.

A83-42706**HEAT TRANSFER AT THE TIP OF AN UNSHROUDED TURBINE BLADE**

R. E. MAYLE (Rensselaer Polytechnic Institute, Troy, NY) and D. E. METZGER (Arizona State University, Tempe, AZ) IN: Heat transfer 1982; Proceedings of the Seventh International Conference, Munich, West Germany, September 6-10, 1982. Volume 3. Washington, DC, Hemisphere Publishing Corp., 1982, p. 87-92.

The pressure difference between the suction and pressure sides of axial turbine stage unshrouded blades induces a flow through the clearance gap between the blade tip and adjacent wall whose combined temperature and heat transfer coefficient effects can lead to blade tip structural damage. The relative motion between parallel walls of the gap is a complicating factor, especially in the case of very small gap heights obtained through active clearance control. Attention is presently given to theoretical arguments and experimental results which help to specify the probable temperature of the pressure side flow entering the gap, and indicate that the blade tip heat transfer coefficients are basically independent of the relative motion between blade and stationary wall. O.C.

A83-42709**PRESSURE LOSS AND HEAT TRANSFER THROUGH MULTIPLE ROWS OF SHORT PIN FINS**

D. E. METZGER, Z. X. FAN, and W. B. SHEPARD (Arizona State University, Tempe, AZ) IN: Heat transfer 1982; Proceedings of the Seventh International Conference, Munich, West Germany, September 6-10, 1982. Volume 3. Washington, DC, Hemisphere Publishing Corp., 1982, p. 137-142. refs

Results are presented showing performance in terms of pressure loss and heat transfer for arrays of short pin fins set in a high aspect ratio duct. Seven array configurations were fabricated and tested, typical of those used for heat transfer augmentation in gas turbine airfoil cooling. All configurations have uniform regular pin spacing with alternate rows in the streamwise direction staggered one-half the transverse pitch. The short length of the pins dictates that the uncovered duct walls are a significant fraction of the total heat transfer area. Comparison is made between the present short pin results and established tube bank performance where the tube surfaces account for all the heat transfer area. Author

A83-42836#**LASERS AND AVIONIC INTEGRATION**

J. S. WILLIAMS (British Aerospace PLC, Aircraft Group, Kingston, Surrey, England) IN: The impact of lasers on avionic systems; Proceedings of the Symposium, London, England, March 23, 1983. London, Royal Aeronautical Society, 1983, 12 p.

Interrogative applications of laser technology are considered, taking into account the extent to which a centralized source of information can be used to service a number of functions which need to be performed in an airframe, and, in addition, also the potential of the laser as probing device. Aspects of laser technology and air vehicle communications are discussed along with laser based techniques for processing and storage of information. Attention is given to data transmission within the aircraft, communications external to the air vehicle, Fourier optics, holographic methods, real-time processing, Bragg cells and spectrum analysis, optical bistable devices, and optical data storage. G.R.

A83-42956**HYDROGEN ASPIRATION IN A DIRECT INJECTION TYPE DIESEL ENGINE ITS EFFECTS ON SMOKE AND OTHER ENGINE PERFORMANCE PARAMETERS**

K. S. VARDE and G. A. FRAME (Michigan, University, Dearborn, MI) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 7, 1983, p. 549-555 refs

A83-42982**ACTIVE CONTROL OF PARAMETER-EXCITED ROTOR SYSTEMS [AKTIVE BEEINFLUSSUNG VON PARAMETERERREGTEN ROTORSYSTEMEN]**

E. ANTON (Muenchen, Technische Universitaet, Munich, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Budapest, Hungary, Apr. 13-16, 1982) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 63, no. 4, 1983, p. T 23, T 26. In German.

Uncontrolled rotor systems running at high operational rotational speeds experience a pronounced deterioration regarding their dynamic characteristics in the case of slight unsymmetries with respect to their structural components. The employment of active magnetic bearings for affecting the vibrational characteristics of the rotor system is considered. This approach makes it possible to exert horizontal control forces on a vertically placed multisection rotor. Attention is given to a mathematical description of the parameter-excited system, the inherent characteristics of the system in a coordinate system which is fixed relative to the revolving rotor, controllability considerations, and mathematical details concerning the control operation. G.R.

A83-42986

**THE DYNAMICS OF SPATIAL LINKED QUADRANGLE CHAINS
[ZUR DYNAMIK RAEUMLICHER GELENKVIERECKKETTEN]**

M HILLER and C. WOERNLE (Stuttgart, Universitaet, Stuttgart, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Budapest, Hungary, Apr 13-16, 1982) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol 63, no. 4, 1983, p T 60-T 62 In German

Transmission mechanisms based on the use of linked quadrangles are often used in technological applications for the mechanical transfer of motions and loads. Examples for such a use are related to rudder actuating mechanisms in the case of small aircraft and the deployment of satellite antennas. The present investigation is concerned with the dynamic behavior of linked quadrangle chains with arbitrary structural characteristics. The considered problem involves a holonomic system with one degree of freedom of motion. With respect to its orientation, the employed approach is based on the kinematic structure of the linked quadrangle chain, and use is made of the uniform structure of the individual linked quadrangle. The suitability of the described procedure for practical applications and the numerical reliability of the approach were successfully tested with the aid of a number of examples. Particular attention was given to the dynamical study of an aircraft aileron actuating mechanism with a chain of 17 linked quadrangles. G.R

A83-43337

HIGH-SPEED FLOATING-RING BEARING TEST AND ANALYSIS

R J. TRIPPETT and D. F. LI (GM Research Laboratories, Warren, MI) American Society of Lubrication Engineers, Annual Meeting, 38th, Houston, TX, Apr. 24-28, 1983 9 p. refs (ASLE PREPRINT 83-AM-3E-2)

Testing of small high-speed floating-ring bearings, typical of those used in automotive turbochargers, revealed a discrepancy between ring speed measurements and ring speed predictions using isothermal bearing analysis. As bearing stability, energy loss, and load capacity are dependent on ring speed, an experimental program was undertaken to determine the effects of various bearing parameters on ring speed. The program results show that none of the 16 bearing parameters investigated increased the bearing ring speeds to those values predicted by the isothermal bearing analysis. In parallel with the experimental program, a thermal analysis was developed in which the effects of lubricant and bearing temperature on the ring speed of a floating-ring bearing was investigated. The ring speed predictions from this thermal floating-ring bearing model agree with the measured values except at the lowest and highest speeds tested. Therefore, for the type of floating-ring bearing design described in this paper, it is concluded that thermal heating can contribute significantly to ring-speed reduction. Author

A83-43365#

THE ONE-DIMENSIONAL ANALYSIS OF FIN ASSEMBLY HEAT TRANSFER

M MANZOOR, D B INGHAM, and P. J. HEGGS (Leeds University, Leeds, England) ASME, Transactions, Journal of Heat Transfer (ISSN 0022-1481), vol 105, Aug 1983, p 646-651. refs

The design of finned surfaces is conventionally performed in two stages. First the fin efficiency is determined by simultaneously analyzing the conductive heat flow within the fin, and the convective heat dissipation from the surface of the fin. Then, the effects of the thermal interaction between the supporting interface and the fins and the convective heat exchange at the plain side of the supporting interface are incorporated by employing a technique based on electric circuit theory. In this study, it is shown that this technique in fact has a mathematically rigorous foundation. It is also shown that, for design purposes, there is a far superior alternative to the fin efficiency. Author

A83-43688#

UNSTEADY AERODYNAMIC FORCES AND FLUTTER ANALYSIS FOR A WING-AILERON-TAB CONFIGURATION

Y. YANG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) and J CHENG (Shanghai Aircraft Design and Research Institute, Shanghai, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol 4, March 1983, p. 1-7 In Chinese, with abstract in English. refs

An analysis of unsteady aerodynamic forces and flutter for a wing-aileron-tab configuration by doublet-lattice method is presented. Six cases with box numbers 41, 68, 92, 130, 154, and 182 are calculated, finding a maximum variance of flutter velocity and flutter frequency of 6.92 percent and 2.24 percent respectively. The difference between calculated and experimental flutter velocities is 18.8 percent to 24.4 percent. The results demonstrate that the method provides enough convergence and accuracy for engineering applications. C D

A83-43691#

THREE THEOREMS OF WEIGHT CHARACTERISTICS OF STATICALLY DETERMINATE AND INDETERMINATE STRUCTURES AND THEIR APPLICATION

Y FENG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol 4, March 1983, p 22-26. In Chinese, with abstract in English

A83-43692#

A CRACK GROWTH FATIGUE LIFE UNDER SPECTRUM LOADING

B. YANG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol 4, March 1983, p. 27-35 In Chinese, with abstract in English. refs

Based on the mechanism of delayed retardation, an analytical equation for predicting the retardation parameter has been formulated. A model for predicting the retardation under tensile overloads and tensile-compressive overloads is presented which can predict the fatigue life of structures under complex spectrum loading. Numerical examples of the retardation of some specimens under different loading conditions are calculated. The fatigue lives of the stiffened panel of a wing and the landing gear of an aircraft under spectrum loadings have been predicted, and the results agree with experimental data. C D

A83-43733

ALGORITHMIC MASS-FACTORING OF FINITE ELEMENT MODEL ANALYSES

P. J. PINCHA (Boeing Military Airplane Co., Seattle, WA) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 26 p. (SAWE PAPER 1451)

A serious problem for weight technology engineers is related to the interpretation, manipulation, or conversion of Finite Element Modeled (FEM) Structural Optimization and Analyses Programs (SOAP's) sized structural data into realistic estimates of projected 'as-built' airframe weight. During preliminary design of aircraft structures, particularly low-aspect-ratio wings (having multiloading paths), initial structural analysis and sizing is almost universally accomplished using a FEM-SOAP system. The output of the FEM-SOAP is the weight of a theoretical structure. However, the weight engineer must use this theoretical weight as a base in the development of an 'as-built' total weight estimate. The present investigation provides a unique algorithmic mass factoring method which accommodates the complexity of the FEM and presents the weight of 'as-built' structure in terms familiar to the weight engineer. G.R.

A83-43754

ADVANCED TECHNOLOGY WING STRUCTURE

J. L. MARIS (Vought Corp., Dallas, TX) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 21 p.
(SAWE PAPER 1487)

A full scale structural wing box was fabricated and tested in this advanced development program. The designs were selected from candidate wing box concepts that were rated for cost, weight, technology improvement, damage tolerance, and the 'abilities' Development testing was conducted on this program and significant tests and test results are reviewed. Full-scale box testing included 2 lifetimes fatigue testing and then installation of intentional flaws followed by damage tolerance testing to element failure Residual strength test after the spar cap element failure demonstrated fail safe features of the design. Author

A83-43757

APPLICATION OF FINITE ELEMENT ANALYSIS TECHNIQUES TO THE DERIVATION OF ADVANCED COMPOSITE STRUCTURE WEIGHT

J. W. BRUNO (Grumman Aerospace Corp., Bethpage, NY) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 21 p.
(SAWE PAPER 1490)

A weight estimate for the SAAB-JA-37 Viggen Advanced Composite Vertical Stabilizer was performed using the results obtained from FASTOP, a finite element analysis for aerosurface structures where combined strength and flutter speed requirements are present. A description of FASTOP's integrated interdisciplinary analysis and modeling process is included. The weight estimating procedure involved the interpretation of theoretical model element and member weights and the application of the appropriate non-optimum factors to project realistic component and assembly weights. The correlation of the factored finite element weights and the drawing-calculated weight for covers was good. Correlation was satisfactory for spars, however, ribs require more study. Author

A83-43815

THE DEVELOPMENT OF QUARTZ-MEMBRANE PRESSURE TRANSDUCERS AT THE AERONAUTICAL RESEARCH AND TEST INSTITUTE [VYVOJ SNIMACU TLAKU S KREMIKOVU MEMBRANOU VE VZLU]

J. LUKAS Zpravodaj VZLU (ISSN 0044-5355), no 1, 1983, p. 27-37 In Czech

The advantages of quartz-membrane pressure transducers, designed for aviation applications, are described. Consideration is given to the types of quartz-membrane elements, techniques for fastening them in the transducer, and the compensation of the temperature effect on the main characteristics of the transducer. B.J.

N83-30684# Shock and Vibration Information Center (Defense), Washington, D. C.

THE SHOCK AND VIBRATION BULLETIN, NO. 52. PART 1: WELCOME, KEYNOTE ADDRESS, INVITED PAPERS, ROTOR DYNAMICS AND MACHINERY VIBRATION

May 1982 148 p refs The 52nd Symp. on Shock and Vibration, held at New Orleans, 26-28 Oct. 1981 5 Vol (BULL-52-PT-1) Avail: NTIS HC A07/MF A01 CSCL 20K

The measurement and dynamic analysis of the vibration of rotor systems and of other machine parts are discussed as well as techniques for determining the vulnerability of structures to the effects of nuclear and conventional weapons.

N83-30729# State Univ. of New York at Buffalo, Amherst. Dept. of Civil Engineering.

ACTIVE VIBRATION CONTROL OF LARGE FLEXIBLE STRUCTURES

T. T. SOONG and J. C. H. CHANG In Shock and Vibration Inform. Center The Shock and Vibration Bull., No 52 Part 4 p 47-54 May 1982 refs

(Contract NSF CEE-80-10891)

Avail: NTIS HC A08/MF A01 CSCL 20K

Active vibration control of large and complex structures is described. An important problem of actively controlling large flexible structures is one of compensating for control and observation spillover when a large dimensional system must be controlled by a much smaller dimensional controller. A modal control design procedure is developed which not only insures that the controlled structural modes stay close to the designed values but also preserves stability in the uncontrolled modes. The sensitivity of spillover compensation to the placement of controllers and sensors is also studied. Author

N83-30758# Syston Donner Corp., Concord, Calif.

A PRECISION INERTIAL ANGULAR VIBRATION MEASURING SYSTEM

H. D. MORRIS, R. B. PETERS, and P. H. MERRITT (AFWL) In Shock and Vibration Information Center The Shock and Vibration Bull., no 50, part 2 p 1-10 Sep. 1980 refs 4 Vol.

Avail: NTIS HC A12/MF A01 CSCL 14B

An instrumentation system is described which permits high precision broadband angular vibration measurements or real time image motion compensation in typical aircraft environments. The system consists of a proprietary dynamic inertial angular displacement sensor calibrated by a special purpose table which is capable of producing and measuring sinusoidal motions up to one milliradian peak amplitude from 1 Hz to over 500 Hz. For a typical flight application, system accuracy is estimated as 0.3 arc seconds, 1 sigma for data in the optimum 70 Hz to 500 Hz band, and 1.4 arc seconds from 1 Hz to 1500 Hz. These estimates include environmental effects. Actual flight data is presented which verifies the estimated accuracy. M.G.

N83-30813# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.

WIND-TUNNEL RESEARCH OF FLOWFIELDS WITHIN NATURALLY VENTILATED ROOMS OF SIMPLE GEOMETRY

M. POREH, J. E. CERMAK, and J. A. PETERKA Sep. 1982 64 p refs

(Contract DE-AC03-80SF-11510)

(DE83-008110, DOE/SF-11510/T1) Avail: NTIS HC A04/MF A01

The flowfield created within a box like structure containing two windows was investigated for three configurations of the structure. The pressure distributions on the closed windows and the pressure at the same locations with open windows were measured and related to the approach flow. The mean air speed and the turbulence intensities near the windows and at various locations inside the rooms were measured using an omni-directional hot-film probe and a vertical, cylindrical hot-film probe. The air speed inside the room and at the windows was related to the approach flow and the pressures on the closed windows. Flow visualization using smoke and cotton tufts was used to study the flow patterns and the direction of the air flow at various locations inside each structure. Black and white photographs showing the basic features of the flow are presented. DOE

N83-30895# AEG-Telefunken, Ulm (West Germany)
Geschaeftsbereich Hochfrequenztechnik.

A MM-WAVE COLLISION WARNING DEVICE FOR HELICOPTERS

B REMBOLD, H. G. WIPPICH, M BISCHOFF, and W F. X. FRANK *In* AGARD Propagation Aspects of Frequency Sharing, Interference and System Diversity 9 p Mar. 1983 refs

Avail: NTIS HC A18/MF A01

Using the frequency slot of maximum atmospheric attenuation around 60 GHz a short range collision warning device for helicopters was developed. The system consists of a pulsed radar sensor using semiconductors exclusively, a fast scanning mechanism and a display. First measurements show that high voltage transmission lines with diameters of about 20 mm can be detected at a distance of more than 400 m E.A.K.

N83-30905# Army Communications-Electronics Command, Fort Monmouth, N.J. Center for Systems Engineering and Integration.
PROPAGATION PREDICTION USAGE IN AUTOMATED FREQUENCY ASSIGNMENTS BASED ON COSITE AND REMOTE SYSTEM SPECTRUM SHARING

S. M. SEGNER *In* AGARD Propagation Aspects of Frequency Sharing, Interference and System Diversity 9 p Mar 1983 refs

Avail: NTIS HC A18/MF A01

This paper covers the use of propagation predictions in the US Army (automated) Battlefield Spectrum Management and Engineering (ABSM&E) capability development program. This program is divided into nine tasks. The major task is the US Army (automated) Tactical Frequency Engineering System (ATFES) Pilot Program. This task will set up the experimental and test structure by fielding vertical slice of an integrated capability in US Army Europe. These ADP systems will initially spectrum manage LOS, TROPO, and HF systems. Eventually, all communications and electronic (radar, sensors and avionics) will be managed by new software now in development for these spectrum assesses of command control and weapons systems. A major function of ABSM&E is to provide coordination of friendly force use of spectrum with friendly force ECM systems. The basic common interest here is the propagation aspect of each spectrum dependent system in each community. Author

N83-30921# Thomas Electronics Inc., Wayne N. J.
MANUFACTURING METHODS AND TECHNOLOGY (MM&T) SPECIFICATIONS FOR MINIATURE CATHODE RAY TUBE Quarterly Report, 1 Oct. - 31 Dec. 1982

F. M. BRUNO 31 Jan 1983 20 p

(Contract DAAK70-80-C-0168)

(AD-A127160, TEI-A009-9, QR-9) Avail: NTIS HC A02/MF A01 CSCL 09A

Improvements in vibration-testing techniques led to the satisfactory performance of CRTs in continuing pre-vibration tests. Pending final approval of its ATP and QTP, TEI was fabricating CRT components preparatory to manufacture and test of phase 2 - Confirmatory samples. Life testing of the P43 phosphor was successfully concluded. GRA

N83-30957*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

AIR MODULATION APPARATUS Patent Application

D T. LENAHA, R. J. CORSMEIER, and A. P. STERMAN, inventors (to NASA) 25 Feb. 1981 18 p

(NASA-CASE-LEW-13524-1, US-PATENT-APPL-SN-238257)

Avail: NTIS HC A02/MF A01 CSCL 20D

An air modulation apparatus, such as for use in modulating cooling air to the turbine section of a gas turbine engine includes a valve means disposed around an annular conduit, such as a nozzle, in the engine cooling air circuit. The valve means, when in a closed position, blocks a portion of the conduit, and thus reduces the amount and increases the velocity of cooling air flowing through the nozzle. The apparatus also includes actuation means, which can operate in response to predetermined engine conditions, for enabling opening and closing of the valve. NASA

N83-30959*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

AEROTHERMAL MODELING PROGRAM, PHASE 1 Final Report, Jul. 1982 - May 1983

G J STURGESS Jul. 1983 190 p refs

(Contract NAS3-23524)

(NASA-CR-168202; NAS 1.26:168202; PWA-5907-19) Avail:

NTIS HC A09/MF A01 CSCL 20D

The physical modeling embodied in the computational fluid dynamics codes is discussed. The objectives were to identify shortcomings in the models and to provide a program plan to improve the quantitative accuracy. The physical models studied were for: turbulent mass and momentum transport, heat release, liquid fuel spray, and gaseous radiation. The approach adopted was to test the models against appropriate benchmark-quality test cases from experiments in the literature for the constituent flows that together make up the combustor real flow. Author

N83-30960*# Purdue Univ., Lafayette, Ind. Thermal Sciences and Propulsion Center

STAGNATION REGION GAS FILM COOLING: EFFECTS OF DIMENSIONLESS COOLANT TEMPERATURE Final Report

M A. BONNICE and M R. LECUYER Jul. 1983 192 p refs

(Contract NSG-3071)

(NASA-CR-168197; NAS 1.26:168197) Avail: NTIS HC A09/MF A01 CSCL 20D

An experimental investigation was conducted to mode the film cooling performance for a turbine vane leading edge using the stagnation region of a cylinder in cross flow. Experiments were conducted with a single row of spanwise angled (25 deg) coolant holes for a range of the coolant blowing ratio and dimensionless coolant temperature with free stream-to-wall temperature ratio approximately 1.7 and $Re_{sub D} = 90000$. The cylindrical test surface was instrumented with miniature heat flux gages and wall thermocouples to determine the percentage reduction in the Stanton number as a function of the distance downstream from injection ($x/d_{sub 0}$) and the location between adjacent holes (z/S). Data from local heat flux measurements are presented for injection from a single row located at 5 deg, 22.9 deg, 40.8 deg, from stagnation using a hole spacing ratio of $S/d = 5$. The film coolant was injected with $T_{sub c} / T_{sub w}$ with a dimensionless coolant temperature in the range 1.18 or equal to $\theta_{sub c}$ or equal to 1.56. The data for local Stanton Number Reduction (SNR) showed a significant increase in SNR as $\theta_{sub c}$ was increased above 1.0. Author

N83-30967# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

AN EXPERIMENTAL STUDY INTO THE SCALING OF AN UNSWEPT-SHARP-FIN-GENERATED SHOCK/TURBULENT BOUNDARY LAYER INTERACTION M.S. Thesis Princeton Univ.

W B MCCLURE Jan 1983 123 p refs

(AD-A126919; AFIT-CI-NR-83-6T) Avail: NTIS HC A06/MF A01 CSCL 20D

An experimental study was carried out of the three-dimensional shock wave/turbulent boundary layer flow-field generated by sharp fin with an unswept leading edge at a 10 deg angle-of-attack to the incoming flow. The model was mounted on and normal to either the tunnel floor or a horizontal flat plate. Both tests surfaces generated a fully developed, equilibrium turbulent boundary layer, with incoming thicknesses of 1.29 cm. and .45 cm., respectively. The incoming freestream was at a nominal Mach number of 2.95 and a Reynolds number of 6.3×10^6 to the 7th power/meter. All surfaces were near adiabatic wall temperature. The three objectives of this study were to learn more about the structure of this type of interaction, to examine the scaling of the resulting flow-field, and to obtain a detailed data set with which to compare numerical computations. The results show that the scaling of this type of interaction is dependent upon both local boundary layer thickness and freestream Reynolds number. GRA

N83-30968# Shannon Engineering, Seattle, Wash
FEASIBILITY OF ESTABLISHING A CORRELATION BETWEEN BOUNDARY LAYER GROWTH AND UPSTREAM SHOCK CONDITIONS Final Report, 16 Apr. - 30 Sep. 1982

O. LETH and J. SHANNON 30 Sep 1982 28 p refs
 (Contract F49620-82-C-0059, AF PROJ 2307)
 (AD-A126909; AFOSR-83-0196TR; JS1109; FQ8671-00878)
 Avail: NTIS HC A03/MF A01 CSCL 20D

Data suitable for drag correlations studies were identified. No single data set or combination thereof were found to be adequate for analytic treatment. It is concluded that the technique of simulating higher Reynolds' number effects by boundary layer transition strips is unsuitable for drag correlation studies. An economical test sequence using existing airfoil types in high Reynolds' number tunnels is recommended. GRA

N83-30997# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering.

A PORTABLE PHYSIOLOGICAL DATA RECORDER USING MAGNETIC BUBBLE MEMORY M.S. Thesis

G. R. SIMS Mar 1983 102 p refs
 (AD-A127304, AFIT/GE/EE/83M-2) Avail: NTIS HC A06/MF A01 CSCL 01D

The test documents the physical design of a man-portable digital data acquisition system. Work includes schematics and detail part drawings. The design is essentially a single board computer featuring all CMOS parts. Secondary storage is on a mixed technology board which includes an INTEL 7110 magnetic bubble memory device. GRA

N83-31022# Rocketdyne, Canoga Park, Calif.
RESTARTABLE HIGH POWER GAS GENERATOR Final Report, May 1979 - Aug. 1982

M. G. GANTS Wright-Patterson AFB, Ohio AFWAL Dec 1982 165 p refs
 (Contract F33615-79-C-2004; AF PROJ. 3145)
 (AD-A127291, RI/RD82-224, AFWAL-TR-82-2119) Avail: NTIS HC A08/MF A01 CSCL 21A

A requirement exists for a means of providing large amounts of power on an intermittent basis to special airborne systems. The objective of this effort was to demonstrate the feasibility of restartable, throttleable, LOX/JP-4 gas generator which requires no purge. Rocketdyne designed and fabricated a gas generator, capable of producing 15,000 HP when coupled with a 71% efficient turbine. Hot fire tests were performed, successfully demonstrating purgeless operation, fast start, restartability, hot gas temperature pattern factor, and required power levels. GRA

N83-31028# Rockwell International Corp., Canoga Park, Calif. Energy Technology Engineering Center.

TESTING OF THE MANNESMANN DEMAG OXYGEN COMPRESSOR Final Report

R. A. GRANGER 15 Dec 1982 711 p
 (Contract DE-AC03-76SF-00700)
 (DE83-006801; ETEC-TDR-82-17) Avail: NTIS HC A99/MF A01

The test results from a successful test program that was performed on the Mannesmann Demag Oxygen HP-Compressor, 05 MV 4B are presented. Testing included low and high-pressure nitrogen tests, oxygen performance tests, an oxygen steady-state test, and an oxygen maximum suction pressure test. DOE

N83-31061# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

SOME CONSIDERATIONS ON SHORT CRACK GROWTH BEHAVIOUR IN AIRCRAFT STRUCTURES

Loughton, England Mar. 1983 30 p refs
 (AGARD-R-696, ISBN-92-835-1446-7) Avail: NTIS HC A03/MF A01

The two papers included in this Report were presented at the 52nd Meeting of the Structures and Materials Panel as the first stage of a study of the problems encountered in predicting the behavior of short cracks. The fracture mechanics approach is being used for fatigue life assessment and durability evaluation of aircraft

structures. Conventional crack growth prediction methods applied to smaller crack length ranges have met limited success so far. Short cracks may grow somewhat faster than expected by predictions using fracture mechanics data obtained from long crack specimens. The behavior of short cracks obviously is affected by some analysis and additional secondary loading effects not normally accounted for in the stress intensity determination but having likely effects in short crack growth.

Author

N83-31062# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio
EVALUATION OF SMALL CRACKS IN AIRFRAME STRUCTURES

H. A. WOOD (Aeronautical Systems Div.), J. L. RUDD, and J. M. POTTER In AGARD Some Considerations on Short Crack Growth Behaviour in Aircraft Struct. 12 p Mar. 1983 refs
 Avail: NTIS HC A03/MF A01

Small crack technology applications to airframe structures are discussed. Cracks with the size range of 1/10mm to 1mm have been used as the starting point for evaluating the safe and durable operational limits of older in-service aircraft and as criteria for the design of new structures. The development of these criteria are presented. Evidence of service cracking obtained from teardown inspections is presented to illustrate the characteristic sizes and shapes of cracks at structural fastener holes. Current methods for predicting growth are judged to be less developed than for cracks in larger size ranges. A limited comparison of test and prediction is included. Finally, the influence of small cracks on residual strength and the potential degradation of fail safety are discussed with specific reference to a large transport aircraft. The authors conclude that the analysis of small crack growth behavior is far more complex than for intermediate and large sizes, and suggest additional research particularly the development of experimental data to support methodology development. Author

N83-31178 Texas Technological Univ., Lubbock Dept. of Electrical Engineering
SOME RESULTS AND LIMITATIONS OF PRONY ANALYSIS OF IN-FLIGHT LIGHTNING DATA

T. F. TROST, C. D. TURNER, and C. T. WEN In FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 8 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Recent results have shown that the electromagnetic resonances of an aircraft are excited by lightning. Each resonance is characterized by a particular frequency and damping rate, and these two quantities taken together constitute a "natural frequency". One way to determine the natural frequencies is by applying Prony analysis to waveforms measured during lightning strikes. This involves a numerical technique for fitting a series of damped sinusoids to the measured waveforms. Electric magnetic field waveforms recorded on the N.A.S.A. F-106B aircraft during lightning strikes were analyzed using the Prony technique. A number of natural frequencies were determined, and these are in substantial agreement with the frequencies observed on a laboratory model of the airplane. The process of determining the frequencies is not without difficulties, and some waveforms yield much better results than others. Author

N83-31194 Lightning Technologies, Inc., Pittsfield, Mass.
RECENT LIGHTNING INDUCED VOLTAGE TEST TECHNIQUE INVESTIGATIONS

K. E. CROUCH In FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 19 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Lightning induced voltage testing techniques are discussed. The cause/effect relationships associated with technique procedures which generate a better understanding of test circuit behavior was investigated. The travelling waves propagate in a transverse electromagnetic (TEM) mode at the speed of light. However, due

to reflections and refractions at the junctions of different impedance sections of the aircraft (i.e., wing and tail attachments) the bulk of the wave energy travels distances considerably farther than the nose to tail dimension. Consequently, the wave appears to take longer to reach the tail, which is interpreted as a slower propagation velocity. Travelling electromagnetic waves reflecting and refracting on the aircraft transmission lines control the response of the system during the initial few microseconds of the test. The system itself will govern the current risetime which can be injected due to the reflection/refractions and the low pass filter characteristics of the system. With configurations, current risetimes faster than 100ns do not appear possible. E.A.K.

N83-31199 Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

ELECTROMAGNETIC MEASUREMENTS OF LIGHTNING ATTACHMENT TO AIRCRAFT

P. L. RUSTAN, B. P. KUHLMAN, J. SHOVALTER, and J. REAZER (Technology/Scientific Services) /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 8 p Jun 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

A NOAA WC-130 aircraft instrumented with electromagnetic field sensors was flown in South Florida in close proximity to thunderstorms in the summer of 1981. Electromagnetic field measurements of two direct lightning attachments to the aircraft were recorded in a continuous analog recorder with a frequency response of 2 MHz on 17 July and 26 Aug. The 17 July flash lasted 295 msec and was characterized by about 200 individual pulses with a maximum pulse repetition rate of 1000 pulses/sec. The maximum uniform current of any of the isolated pulses was 650 Amperes. The rise-times of these pulses ranged from less than 350 nsec to about 12 mu-sec. Author

N83-31212 United Kingdom Atomic Energy Authority, Abingdon (England)

NANOSECOND RESOLUTION OF .E, .H AND .I IN AIRCRAFT LIGHTNING TEST RIGS

B. J. C. BURROWS /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 9 p Jun 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Many designs of test rig have emerged in recent years incorporating hardwired connections and design incorporating series open arcs at each end of the aircraft. Important characteristics of the test rigs are not specified, but these characteristics control the generation of large (and usually HF) transients through the fast coupling processes. Both lumped element and distributed element representation of these test rigs and the capacitor banks driving them are given, and the effects of parameter and geometry variations are highlighted. It is shown that quantitative analysis of fast transients (dot-D, dot-B) requires much closer specification of the test rig performance including switch closure time, capacitor bank and connecting line inductance, and the transmission line impedance of the test rig. Tests on the Fly-by-Wire Jaguar at Warton near Preston in England showed the need for developing a quantitative relationship between HF transients and the fast coupling processes. M.G.

N83-31215 Rockwell International Corp., Anaheim, Calif. Autonetics Strategic Systems Div.

USAGE OF THE SYSCAP II CIRCUIT ANALYSIS PROGRAM TO DETERMINE SEMICONDUCTOR FAILURE THRESHOLD LEVELS CAUSED BY LIGHTNING/EMP TRANSIENTS

D. L. RUSHER and C. T. KLEINER /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 6 p Jun. 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

An improved technique for calculating semiconductor junction heating resulting from arbitrary time-varying source terms is

described. A FORTRAN subroutine is developed which permits solution of the convolution integral in the SYSCAP circuit analysis program which will simulate the thermal transient for each semiconductor of interest in a circuit subject to lightning/electromagnetic pulses disturbances. An example circuit is used to demonstrate the techniques, the results compare favorably with laboratory test data. M.G.

N83-31241 Douglas Aircraft Co., Inc., Long Beach, Calif
THE LIGHTNING SPARK BARRIER

M. P. AMASON and M. C. HOFMEISTER /in FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 3 p Jun. 1983 refs

Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00

Lightning protection of modern aerospace vehicles through the prevention of sparking in critical fuel vapor areas is discussed. In the past, it was particularly difficult to keep mechanical fasteners from sparking during a lightning event. Attempts to seal off the fasteners from the critical fuel vapor area by manual application of sealant material were ineffective due to gaps and voids produced by the application process. A technique was developed to control the application of dielectric sealant material to isolate the mechanical fastener sparking from the critical fuel vapor area. The technique consists of a specially designed dielectric cap that fits over the fastener, providing uniform and controlled application of dielectric filler material. An adequate thickness of filler material provides a barrier that prevents the sparks from entering the critical fuel vapor area. The lightning spark barrier is applicable to a wide variety of installations, including those with composite materials. R.J.F.

N83-31912# Brookhaven National Lab., Upton, N. Y.

POLYMER CONCRETE PATCHING MANUAL Final Report, Sep. 1975 - Jun. 1982

J. J. FONTANA and J. BARTHOLOMEW Jun 1982 38 p refs (Contract DOT-FH-61-80-P-30115)

(PB83-180265; BNL-30364-R, FHWA/IP-82/10) Avail: NTIS HC A03/MF A01 CSCL 13B

The practicality of using polymer concrete to repair deteriorated portland cement concrete bridge decks and pavements was demonstrated. This manual outlines the procedures for using polymer concrete as a rapid patching material to repair deteriorated concrete. The process technology, materials, equipment, and safety provisions used in manufacturing and placing polymer concrete are discussed. Potential users are informed of the various steps necessary to insure successful field applications of the material. GRA

N83-31916# National Inst. for Occupational Safety and Health, Cincinnati, Ohio

IN-DEPTH SURVEY REPORT OF AMERICAN AIRLINES PLATING FACILITY

V. D. MORTIMER, JR. 8 Dec. 1982 34 p refs

(PB83-187799) Avail: NTIS HC A03/MF A01 CSCL 06J

An in depth survey was conducted at the American Airlines Maintenance and Engineering Center as part of National Institute for Occupational Safety and Health (NIOSH) study evaluating measures to control occupational health hazards associated with the metal plating industry. This American Airlines plating facility, employing approximately 25 workers, is primarily engaged in plating hard chromium, nickel and cadmium on aircraft engine and landing gear parts. Six tanks were studied, including an electroless nickel tank. Area and personal samples for chromium, nickel, cadmium, and cyanide were collected. Ventilation airflow and tank dimensions were measured and data recorded on plating operations. The relationships between air contaminants emitted, local exhaust ventilation flow rate, tank size, and plating activity were evaluated. GRA

N83-31931# Ohio State Univ., Columbus Electroscience Lab
NEAR FIELD ANALYSIS OF AIRBORNE ANTENNA Final Report

N. WANG and W. D. BURNSIDE Mar. 1983 35 p refs
 (Contract N00019-81-C-0424)
 (AD-A127246; ESL-714215-4) Avail. NTIS HC A03/MF A01
 CSCL 09E

The radiation pattern analysis for the ellipsoid based on the efficient UTD and geodesic solution has been completed. This new ellipsoid configuration will be used to represent the fuselage in future aircraft simulation analyses Author (GRA)

N83-32031# Aeronautical Research Labs., Melbourne (Australia).

OPERATING INSTRUCTIONS MANUAL FOR MICROPROCESSOR AIRBORNE DATA ACQUISITION AND REPLAY (MADAR) MODULE

J. F. HARVEY, C. W. SUTTON, and I. M. KERTON Feb 1983 29 p refs
 (AD-A128558, ARL/AERO-TM-347) Avail. NTIS HC A03/MF A01 CSCL 14C

This user's manual details the operating instructions for MADAR which is a 16 channel analogue input, digital cassette recording system with programmable facilities. Selected data are able to be scaled and periodically displayed on liquid crystal displays GRA

N83-32071# National Aeronautical Establishment, Ottawa (Ontario) Structures and Materials Lab.

AN SEM ANALYSIS OF BEARING FAILURE DUE TO ELECTRICAL ARCING

W. WIEBE and D. D. MORPHY Jan 1983 16 p refs In English; French summary
 (AD-A127827, NRC-20936, NAE-AN-3) Avail. NTIS HC A02/MF A01 CSCL 13I

Failure of a cam clutch after some 2,000 hours of operation was found to be due to bearing failure. When examined in the scanning electron microscope, evidence of molten metal in the form of craters or pools, and of minute globules of metal was found on the balls and races of the bearings. This suggested that electrical arcing between the balls and the races had occurred, and this was considered to be the primary cause of subsequent fatigue and other mechanical damage to these components

Author (GRA)

N83-32095*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

STRUCTURES AND DYNAMICS DIVISION: RESEARCH AND TECHNOLOGY PLANS FOR FY 1983 AND ACCOMPLISHMENTS FOR FY 1982

K. S. BALES Jun. 1983 112 p refs
 (NASA-TM-85661, NAS 1.15 85661) Avail. NTIS HC A06/MF A01 CSCL 20K

The objectives, expected results, approach, and milestones for research projects of the IPAD Project Office and the impact dynamics, structural mechanics, and structural dynamics branches of the Structures and Dynamics Division are presented. Research facilities are described. Topics covered include computer aided design; general aviation/transport crash dynamics; aircraft ground performance; composite structures, failure analysis, space vehicle dynamics, and large space structures A.R.H.

GEOSCIENCES

Includes geosciences (general), earth resources, energy production and conversion, environment pollution, geophysics, meteorology and climatology, and oceanography.

A83-41585

THE SHORT-RANGE FORECASTING OF METEOROLOGICAL CONDITIONS OF THE ICING OF AIRCRAFT ON THE GROUND AND THE RUNWAY AT THE SOFIA AIRPORT [KRATKOSROCHNYI PROGNOZ METEOROLOGICHESKIKH USLOVII OBLEDENENIIA SAMOLETOV NA ZEMLE I VZLETNO-POSADOCHNOI POLOS Y AEROPORTU SOFIIA]

M. I. MARTINOV, N. D. BOGACHEVA, and A. G. BOGACHEV (B'lgarska Akademiia na Naukite, Institut po Khidrologiia i Meteorologiia, Sofia, Bulgaria) Meteorologiia i Hidrologiia (ISSN 0130-2906), July 1983, p. 54-60. In Russian. refs

A83-42210*# National Aeronautics and Space Administration Wallops Flight Center, Wallops Island, Va

AIRBORNE DUAL LASER EXCITATION AND MAPPING OF PHYTOPLANKTON PHOTOPIGMENTS IN A GULF STREAM WARM CORE RING

F. E. HOGE (NASA, Wallops Flight Center, Wallops Island, VA) and R. N. SWIFT (EG & G Washington Analytical Services Center, Inc., Pocomoke City, MD) Applied Optics (ISSN 0003-6935), vol 22, Aug 1, 1983, p. 2272-2281. refs

Utilization of a two-color airborne lidar system in the systematic study of a major oceanographic feature is reported here for the first time. An excimer pumped dye laser was optically and electronically integrated into the NASA Airborne Oceanographic Lidar for simultaneous use with a frequency doubled Nd YAG laser. The output beams exit the laser system along parallel paths after being produced on an alternating pulse basis at a combined rate of 12.5 pps. Results are presented for missions flown over a Gulf Stream Warm Core Ring (WCR) as well as over shelf, slope, Gulf Stream, and Sargasso Sea waters. From the airborne data a high coherence is shown between the two-color chlorophyll a data and between the Nd YAG chlorophyll a and phycoerythrin responses within each of these water masses. However, distinct differences in the response patterns of these photopigments are shown to exist between the differing water masses. At certain of the boundaries separating the water masses a sharp transition is seen to occur, while at others a wider transition zone was observed in which the correlation between the photopigments appears to degrade Author

A83-43641

MODEL OF A CRYOGENIC LIQUID-HYDROGEN PIPELINE FOR AN AIRPORT GROUND DISTRIBUTION SYSTEM

L. JONES (Envirocon Eastern Ltd., Mississauga, Ontario, Canada), C. WUSCHKE (Gulf Canada Resources, Inc., Stettler, Alberta, Canada), and T. Z. FAHIDY (Waterloo, University, Waterloo, Ontario, Canada) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 8, 1983, p. 623-630. refs

The results of a numerical simulation of LH2 transport in an underground insulated pipeline for airport flight fuel are reported. A mechanistic model was developed for LH2 flow, taking into account mass, momentum, and heat balances. Attention was given to the physical and chemical properties of LH2, the overall thermal conductance in gas, solid, and radiative modes, and a 6 km pipe length. A saturated vapor pressure/temperature relationship was defined for H2, and parameter sensitivity was examined. It was found that the significant parameters of the LH2 fuel pipeline could be easily modeled by computer, thereby commending the model for use in designing LH2 transport at airports. M.S.K.

N83-31163 Federal Aviation Administration, Atlantic City, N.J.
**EIGHTH INTERNATIONAL AEROSPACE AND GROUND
 CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY:
 LIGHTNING TECHNOLOGY ROUNDUP**

Jun 1983 846 p refs Conf held in Fort Worth, Tex., 21-23
 Jun. 1983, sponsored in part by Florida Inst of Tech., IEEE, UK
 Civil Aviation Authority, and RAE Sponsored by National
 Interagency Coordination Group
 (FAA-CT-83-25) Avail: IALC-8, FAA Technical Center, ACT-340,
 Atlantic City, N.J. \$25.00

Lightning phenomenology, lightning characterization, modeling
 and simulation, test criteria and techniques, and protection of both
 airborne and ground systems were discussed

N83-31165 Air Force Wright Aeronautical Labs., Wright-Patterson
 AFB, Ohio.

**ATMOSPHERIC ELECTRICITY HAZARDS PROTECTION
 PROGRAM**

R C BEAVIN, J. R. LIPPERT, and J. E. LAVOIE /In FAA Eighth
 Intern. Aerospace and Ground Conf on Lightning and Static Elec
 10 p Jun. 1983
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J.
 \$25.00

The electromagnetic (EM) environment resulting from aircraft
 (A/C) interaction with atmospheric electricity (AE); e.g., lightning
 and precipitation static; will be define and the impact of the
 environment on electrical/electronic subsystems and equipment
 assessed Tradeoffs will then be exercised to prescribe atmospheric
 electricity hazards protection (AEHP) concepts which are
 compatible with protection required against other EM threats. From
 the candidate protection concepts available, optimized AEHP
 schemes for various classes of vehicles; e.g., fighters,
 transports/bombers, helicopters, and missiles, is specified The
 effectiveness of the protection provided will be demonstrated
 through ground based AE simulation utilizing full-scale A/C and
 operating electrical/electronic subsystems and equipment
 employing appropriate AEHP concepts Timely information
 distribution and participation by interested organizations and
 personnel is emphasized. Author

N83-31169 Hochschule der Bundeswehr, Hamburg (West
 Germany)

**DAMAGE OF RFC SURFACE LAYERS BY ELECTROSTATIC
 CHARGING**

D. KOENIGSTEIN /In FAA Eighth Intern. Aerospace and Ground
 Conf on Lightning and Static Elec 10 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J.
 \$25 00

Electrostatic charging of thin insulating superficial paint layers
 applied on the conductive structure, lightning or p-static protection
 system of aircraft parts can lead to mechanical damage due to
 electrical breakdown. For layers of less than approx. 0.25 mm
 thickness the effects can be tested on small samples of the
 interesting material The energy of the discharge and consequently
 the resulting damage is increasing with the breakdown field
 strength of the paint, the thickness of the insulating layer, and
 the conductivity of the conductive layer next to the surface In
 any case, there was little influence of a damaged point on the
 discharging or recharging process of the entire surface The graphic
 presentation of charge distribution showed that only the nearest
 vicinity of a punctured hole remained uncharged. Author

N83-31200 Air Force Wright Aeronautical Labs., Wright-Patterson
 AFB, Ohio

**AIRBORNE MEASUREMENTS OF THE RISETIMES IN
 LIGHTNING RETURN STROKE FIELDS**

P. L. RUSTAN, B. P. KUHLMAN, G. DUBRO, and J. REAZER
 (Technology/Scientific Services) /In FAA Eighth Intern. Aerospace
 and Ground Conf. on Lightning and Static Elec 5 p Jun. 1983
 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J.
 \$25.00

A WC-130 aircraft instrumented with electromagnetic field
 sensors was flown in South Florida in close proximity to
 thunderstorms Electric and magnetic fields were measured over
 one thousand lightning return strokes at distances between 4 and
 35 km from the aircraft These field waveforms were recorded
 with a Digital Transient Recorder with a 25 MHz band-width which
 consists of 8192 samples in 20 nsec intervals. The risetimes for
 over two hundred return stroke magnetic fields have been
 calculated. The average risetime (10% to 90%) of the entire
 waveform for the first return stroke was 1.78 mu-sec with a standard
 deviation of 87 mu-sec. Author

N83-31201 Air Force Wright Aeronautical Labs., Wright-Patterson
 AFB, Ohio

**LIGHTNING FIELD SPECTRA OBTAINED FROM AIRBORNE
 MEASUREMENTS**

B. P. KUHLMAN, J. S. REAZER (Technology/Scientific Services,
 Inc.), W. P. GEREN (Boeing Military Airplane Co.), and P. L.
 RUSTAN (AFIT) /In FAA Eighth Intern. Aerospace and Ground
 Conf on Lightning and Static Elec. 8 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J.
 \$25.00

A WC-130 aircraft was used as an airborne platform for
 broadband electric and magnetic field sensors to measure the
 surface fields on the airframe from lightning strikes in the 7 - 35
 km range. The waveforms were recorded digitally, with a sample
 interval of 20 nsec and a time window of 164 microseconds.
 Since the aircraft was above 15,000 feet, and the lightning source
 was relatively nearby, the effects of ground propagation were
 minimized. Spectral have been obtained for the stepped leader,
 first return stroke, and subsequent return stroke over the frequency
 range 100 kHz to 20 MHz. These spectra are compared to
 published data of lightning field spectra obtained from ground-based
 measurements With airframe resonances and field enhancement
 effects removed, the data have two primary applications: (1) to
 add to the data base for the nearly lightning strike threat, (2) to
 infer characteristics of the stepped leader, first return stroke, and
 subsequent return stroke processes Recommendations for these
 applications are presented. Author

N83-31231 Technische Univ., Hamburg (West Germany)
**ELECTRIC CHARGING BY IMPACT OF HAILSTONES AND
 RAINDROPS**

H. TRINKS and J. L. TERHASEBORG (German Federal Armed
 Forces Univ.) /In FAA Eighth Intern. Aerospace and Ground
 Conf on Lightning and Static Elec. 8 p Jun. 1983 refs
 Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J.
 \$25 00

Hailstones, raindrops, and particles are electrically charged with
 charge values of 10 to the minus 14th power to 10 to the minus
 11th power As. When the particles strike the surface of aircraft or
 rockets, charge transfer processes occur. Especially impacting
 particles with high velocity generate small clouds of dust or water
 vapor This effect is accompanied by strong electric charge
 separation processes An impacting hailstone with a primary charge
 of about $Q_{sub 0} = 10$ to the minus 13th power As generates a
 secondary electric charge transfer of up to $Q = 10$ to the minus
 11th power As Waterdrops and ice particles were shot against
 target plates By electric field measurements and shorttime shadow
 photographs, the impact processes were investigated
 experimentally. Model computations were performed. Author

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general), computer operations and hardware, computer programming and software; computer systems, cybernetics; numerical analysis, statistics and probability; systems analysis, and theoretical mathematics

A83-40674

THE EFFECTS OF NON-LINEAR KINEMATICS IN OPTIMAL EVASION

A. STEINBERG, J. SHINAR (Technion - Israel Institute of Technology, Haifa, Israel), and I. FORTE Optimal Control Applications and Methods (ISSN 0143-2087), vol. 4, Apr.-June 1983, p. 139-152 refs

The effects of non-linear kinematics on optimal evasive strategies from a pursuer guided by proportional navigation are investigated in a plane. Non-linear analysis is mandatory since, for certain values of system parameters and initial conditions, linearized kinematic models are not valid. The investigation discloses two principles of optimal evasion. For long pursuit time, both principles are satisfied and the relatively large miss distance is almost independent of the initial conditions. Short pursuit time does not allow simultaneous satisfaction of both principles, and the two-dimensional optimal compromise results in a reduced miss distance. The inability to satisfy both principles suggests a three-dimensional maneuver perpendicular to the initial collision plane. Author

A83-41477

A NEW APPROACH TO EXACT MODEL-MATCHING WITH APPLICATIONS TO AIRCRAFT SYSTEMS

P. N. PARASKEVOPOULOS (Thrace, University, Komotini, Greece) IN: Control and its applications; Proceedings of the International Conference, Warwick, England, March 23-25, 1981. London, Institution of Electrical Engineers, 1981, p. 17-21. refs

This paper considers the problem of designing a static or a dynamic controller to match exactly the transfer function matrix of a given system to that of a desired model using state or output feedback. Theorems stating necessary and sufficient conditions for exact model-matching are established. The proposed method simplifies significantly the design over certain known optimal control model-matching techniques as demonstrated by two practical aircraft design problems. Author

A83-41659

GUIDANCE AND CONTROL CONFERENCE, GATLINBURG, TN, AUGUST 15-17, 1983, COLLECTION OF TECHNICAL PAPERS

Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1983, 937 p.

Various topics in guidance and control are addressed. Among the subjects discussed are: integrated airframe/propulsion control system architectures, comparative evaluation of maneuvering target tracking algorithms, line of sight reconstruction for faster homing guidance, simulator applications and technology, flight test results using nonlinear control with the F-8C digital fly-by-wire aircraft, dynamic isolation via momentum compensation for precision instrument pointing, and a reference for sub-arcmin attitude sensing on flexible space structures. C.D.

A83-41664#

A COMPARATIVE EVALUATION OF SOME MANEUVERING TARGET TRACKING ALGORITHMS

C.-F. LIN and M. W. SHAFROTH (Wisconsin, University, Madison, WI) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 39-56. refs (AIAA PAPER 83-2168)

Representative examples of the approximate Bayes approaches and the input estimation approaches to the maneuver tracking

problem of air traffic control are compared with a Singer solution suggested by McAulay and Denlinger (1973). The derivation and expected performances of these algorithms are compared and their actual performances over two trajectories of interest are assessed using Monte Carlo simulation and conventional statistical comparison. The approximated Bayes tracker performed well as expected on the Bar-Shalom/Birmiwal trajectory, which consists of two square pulses of acceleration resulting in a U-shaped trajectory. The simple input estimation scheme, as expected, did not perform well on this trajectory nor on the minimum time half-loop for a lightweight, high thrust-to-weight ratio fighter. The Singer solution failed to meet expectations on a pull-up maneuver. C.D.

A83-41759#

A GENERALIZED STAGE-STATE METHOD FOR CENTRALIZED FAULT-TOLERANT FLIGHT CONTROL SYSTEM

H.-C. CHEN (Boeing Commercial Airplane Co., Seattle, WA) and A. D. STERN (Boeing Military Airplane Co., Wichita, KS) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 874-881. Research supported by the Boeing Independent Research and Development Program.

(AIAA PAPER 83-2301)

The generalized stage-state method presented provides a powerful capability for performing reliability analyses of very complex control systems based on innovative designs. The development of a programmable bookkeeping system is considered essential for the computer program development based on the generalized stage-state method for centralized control systems in NASA's integrated airframe/propulsion control system architecture study. A highly centralized control system using analytic redundancy is successfully analyzed. It is shown that a centralized control system employing analytic redundancy can lead to a very complex super-stage with numerous success states. It is also demonstrated that centralized redundancy management can greatly improve system reliability. C.R.

A83-41760*# Bendix Corp., Teterboro, N. J.

NEW RESULTS IN FAULT LATENCY MODELLING

J. G. MCGOUGH, F. L. SWERN (Bendix Corp., Teterboro, NJ), and S. BAVUSO (NASA, Langley Research Center, Langley, VA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 882-889. refs (AIAA PAPER 83-2303)

Studies carried out by McGough and Swern (1981, 1983) are summarized. In these studies, an avionics processor was simulated and a series of fault injection experiments was carried out to determine the degree of fault latency in a redundant flight control system that employed comparison monitoring as the exclusive means of failure detection. A determination was also made of the fault coverage of a typical self-test program. The summary presented stresses that a self-test program should be designed to capitalize on the hardware mechanization of the processor. If this is not done, subtests tend to repeatedly exercise the same hardware components while neglecting to exercise a substantial proportion of the remainder. It is also pointed out that fault latency is relatively independent of both the length and instruction mix of a program. A significant difference is found in fault coverage assessed using pin-level and gate-level fault models. C.R.

A83-41761#

INTERACTIVE REDUCTIONS IN THE NUMBER OF STATES IN MARKOV RELIABILITY ANALYSIS

J. H. LALA (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 890-897. refs (AIAA PAPER 83-2304)

The practical difficulties that have been encountered in solving Markov models are mentioned. A solution is proposed that involves partitioning the model into a number of smaller submodels, solving

the submodels independently, and then combining the submodel state probabilities using Boolean algebra to produce state probabilities corresponding to states of the main model. A program that performs most of these functions is described. It accepts descriptions of models, solves the models numerically for the specified time period, interprets Boolean equations to combine the states, and outputs desired probabilities of 'super-states', that is, states of the main model, or a Boolean combination of super-states. It is noted that a Markov model is specified by the number of states in the model and the nonzero transition rates among the states. The program can be used to solve models of any system that follows the Markovian processes. One of the systems that the program has been used to model is a fault-tolerant full-authority engine control system for a jet engine that includes sensors, a digital computer, and actuators. C.R.

A83-41944#**PURSUIT-EVASION BETWEEN TWO REALISTIC AIRCRAFT**

C. HILLBERG (Chalmers Tekniska Hogskola, Gothenburg, Sweden) and B. JAEERMARK (Saab-Scania AB, Linköping, Sweden). American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Gatlinburg, TN, Aug 15-17, 1983. 7 p. refs (AIAA PAPER 83-2119)

Differential game problems consisting of two aircraft with variable speed in coplanar motions are analysed by the differential dynamic programming method. The formulation is made as a pursuit-evasion problem, with the final range, at the specified final time, as the measure of the game. In aiming for solving realistic problems an important fact is that the longitudinal acceleration of each aircraft depends on speed, turning rate and the throttle setting. The turn rate is constrained by structural as well as stall limits. The results point out the importance of the ability to optimize a non-linear problem. For example in some situation a throttle off for a few seconds gives a considerable influence on the optimal cost value. Also, for the new generation of high performance aircraft it will be more important to be able to choose the optimal initial velocity for the different tactical situations that may occur. Good acceleration performance should therefore be combined with adequate deceleration means such as airbrakes. Author

A83-42568#**VECTOR OPTIMIZATION APPLIED TO SURVIVABILITY METHODOLOGY EVALUATION**

K. W. BUBB, A. R. DEWISPELARE, and H. C. BRIGGS (USAF, Institute of Technology, Wright-Patterson AFB, OH). IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 14-5-1 to 14-5-6. refs

The optimal methodology selection process provides a structured way of evaluating and selecting survivability methodologies for aircraft design. The state space/vector optimization scheme allows the use of vector optimization techniques to obtain the descriptors of optimal methodologies. These descriptors provide a means to uniquely specify or describe the contents of a methodology. The worth of a methodology is measured by mathematical relations in the model and by the model structure. A weighting technique and figure of merit calculation can be used to select the one methodology from the set of optimal methodologies which best meets the requirements of the analyst. The weighting technique converts these requirements into coefficients which reflect the relative importance of individual performance indices. The figure of merit calculation forms a scalar score for each methodology which ranks them. C.D.

A83-42575#**LOW COST ANTENNA POINTING SYSTEM**

J. J. FOSHEE (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). IN: Annual Mini-Symposium on Aerospace Science and Technology, 9th, Wright-Patterson AFB, OH, March 22, 1983, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1983, p. 17-3-1 to 17-3-3. (Contract F33615-82-C-1872)

The development of a computational algorithm with specified accuracy requirements which will output relative range, relative range-rate and antenna pointing information from an aircraft to a satellite in space involves a number of technical/cost tradeoffs. The LCAPS program has three major objectives: first, a study effort to identify/evaluate the various trade-offs; second, an analysis/development of a computational algorithm; and third, the implementation of the algorithm in computer software. The computer implementation will allow an evaluation of the algorithm, including long term and short term accuracy as well as sensitivity to various input parameters. Author

A83-43699#**COMPLEX COMBINED CURVE DESIGN AND FITTING - A B-SPLINE MULTIPLE KNOT METHOD**

A. YAO, R. ZHOU, and Q. DING (Nanjing Aeronautical Institute, Nanjing, People's Republic of China). Acta Aeronautica et Astronautica Sinica, vol. 4, March 1983, p. 95-102. In Chinese, with abstract in English. refs

A multiple-knot method based on a non-uniform B-spline is adopted to design and fit complex combined curves. The problem of reducing the order in a linear equation set for varieties of multiple knots in inverse calculation for the vertices of a characteristic polygon has been solved and a unified expression has been obtained. The program provided in this paper is flexible and convenient for fitting, designing, and modifying complex combined curves quickly in every possible case. This method can offer a more universal tool for using the B-spline in computer-aided geometric design and drawing. Author

A83-43755**LEONARDO - A COMPUTER-AIDED ENGINEERING SYSTEM**

F. A. DELLAMURA (Grumman Aerospace Corp., Bethpage, NY). Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 21 p. (SAWE PAPER 1488)

LEONARDO is a program, at Grumman, that will integrate computer aided design (CAD) and computer aided analysis (CAA) into a unified computer aided engineering (CAE) system. Its primary purpose is to accelerate the conceptual/preliminary design cycle in Advanced Aircraft Systems. The key feature is to establish a link between the designer and the battery of analytical tools through a single architecture and data base. The philosophical approach taken is that design is a complex art that cannot be reduced to a rigid flow chart and coded. Each designer has his own style, each design requires a unique attack, each project requires its own special considerations. A user-oriented system must accommodate all of these variables. Author

N83-31233* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DIGITAL SYSTEM UPSET: THE EFFECTS OF SIMULATED LIGHTNING-INDUCED TRANSIENTS ON A GENERAL PURPOSE MICROPROCESSOR

C. BELCASTRO. In: FAA Eighth Intern. Aerospace and Ground Conf. on Lightning and Static Elec. 12 p. Jun. 1983. refs. Avail: IALC-8, FAA Technical Center, ACT-340, Atlantic City, N.J. \$25.00. CSCL 09B

Flight-critical computer-based control systems designed for advanced aircraft must exhibit ultrareliable performance in lightning-charged environments. Digital system upset can occur as a result of lightning-induced electrical transients, and a methodology was developed to test specific digital systems for upset susceptibility. Initial upset data indicates that there are several distinct upset modes and that the occurrence of upset is related

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to the relative synchronization of the transient input with the processing state of the digital system. A large upset test data base will aid in the formulation and verification of analytical upset reliability modeling techniques which are being developed.

Author

N83-32387# Bell Aerospace Co., Buffalo, N. Y. Structure and Vehicle Systems Directorate

FORCE METHOD OPTIMIZATION II. VOLUME 2: USER'S MANUAL Final Report, Aug. 1980 - Dec. 1982

J. R. BATT, B. J. DALE, S. C. SKALSKI, D. L. WITKOP, and S. GELLIN Wright-Patterson AFB, Ohio AFWAL Nov. 1982 212 p refs

(Contract F33615-80-C-3214; AF PROJ 2307)

(AD-A128235, AFWAL-TR-82-3088-VOL-2) Avail: NTIS HC

A10/MF A01 CSCL 09B

This technical paper describes the Table Computation Program (TCP) developed to facilitate the manipulation and presentation of tabular information for analysis and analysis reporting purposes. This document includes an overview of how the program functions and instructions on how to use it. In addition, technical information is provided for those who may wish to modify or expand the program to satisfy unique requirements

GRA

N83-32397*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

NUMERICAL AERODYNAMIC SIMULATION (NAS)

V. L. PETERSON, W. F. BALLHAUS, JR., and F. R. BAILEY Jul 1983 25 p refs Presented at the Conf. on Large Scale Sci Computation Submitted for publication

(NASA-TM-84386, A-9404, NAS 1 15 84386) Avail: NTIS HC

A02/MF A01 CSCL 09B

The history of the Numerical Aerodynamic Simulation Program, which is designed to provide a leading-edge capability to computational aerodynamicists, is traced back to its origin in 1975. Factors motivating its development and examples of solutions to successively refined forms of the governing equations are presented. The NAS Processing System Network and each of its eight subsystems are described in terms of function and initial performance goals. A proposed usage allocation policy is discussed and some initial problems being readied for solution on the NAS system are identified

Author

N83-32401# Illinois Univ., Urbana-Champaign Coordinated Science Lab

AN EXPERT DISTRIBUTED ROBOTICS SYSTEM WITH COMPREHENSION AND LEARNING ABILITIES IN THE AIRCRAFT FLIGHT DOMAIN Annual Technical Report, 1 Jan. - 30 Dec. 1982

D. L. WALTZ, G. DEJONG, and R. T. CHIEN Feb. 1983 48 p refs

(Contract F49620-82-K-0009; AF PROJ 2394)

(AD-A127739; AFOSR-83-0334TR, T-123) Avail: NTIS HC

A03/MF A01 CSCL 06D

The goals of this project are to better understand the processes involved in reasoning about and troubleshooting physical mechanisms. This will lay the foundation for the design of expert systems to carry out these processes automatically. Of particular interest are results that will allow novel applications for the aircraft flight domain. The work falls into three broad areas: understanding natural language; learning; and mechanism modeling

GRA

N83-32408# Textron Bell Aerospace Co., Buffalo, N. Y. **FORCE METHOD OPTIMIZATION 2. VOLUME 1: THEORETICAL DEVELOPMENT Final Technical Report, Aug. 1980 - Dec. 1982**

J. R. BATT, S. GELLIN, and R. A. GELLATLY Wright-Patterson AFB, Ohio AFWAL Nov. 1982 126 p refs

(Contract F33615-80-C-3214; AF PROJ 2307)

(AD-A127073, AFWAL-TR-82-3088-VOL-1) Avail: NTIS HC

A07/MF A01 CSCL 12A

The document investigates the utilization of the force method of finite element analysis for the automatic iterative design of aircraft structures with stress, displacements, maximum and

minimum size and dynamic constraints. It develops a rapid reanalysis method based on the force method for damage assessment. Research has resulted in a computer code named OPTFORCE II an expansion of code OPTFORCE I. Multiple loading capabilities and four finite elements have been included. These are: membrane triangle, membrane quadrilateral, shear panel and bar (axial force). Examples of problems solved by the OPTFORCE II code are presented and compared to the optimization code OPTIM III for purposes of establishing the efficiency of the force method vs. the 'displacement' method of analysis. A technical discussion of the research conducted is presented wherein conclusions and recommendations for future research topics are given

GRA

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PHYSICS

Includes physics (general); acoustics, atomic and molecular physics; nuclear and high-energy physics, optics, plasma physics, solid-state physics, and thermodynamics and statistical physics.

A83-42617

UNIVERSITIES - HAVE THEY A ROLE IN AERONAUTICAL RESEARCH? NOISE RESEARCH

I. C. CHEESEMAN (Southampton, University, Southampton, England) Aeronautical Journal (ISSN 0001-9240), vol. 87, June-July 1983, p. 210-218 refs

In discussing jet noise, it is pointed out that the essence of university research must be an understanding of the physics of effects thought to be important in the aeroacoustic noise context. This is achieved through theoretical modeling and small-scale experiments. The contributions made in this area by Morfey (1973), Lilley (1974), and Howe (1975) are discussed. Attention is also given to helicopter research, and it is shown how well university work can be integrated into industrial development. Universities also provide an arena where the validity of novel ideas can be established so that industry can assess their commercial value

C R

N83-30715# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab

YC-15 EXTERNALLY BLOWN FLAP NOISE

L. G. PECK In Shock and Vibration Inform Center The Shock and Vibration Bull., No 52 Part 3 p 101-113 May 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 20A

The purpose of this project is to determine the acoustic environment on the wing/flap region of the McDonnell-Douglas YC-15 Short Takeoff and Landing cargo aircraft. The YC-15 is designed for augmented lift through the use of externally blown flaps deflecting the jet exhaust thereby turning the flow and increasing lift. This process creates an intense acoustic environment on the wing/flap region. Ten transducers on the right inboard wing/flap were selected for data analysis. Test conditions included takeoff, landing, taxi, cruise and ground static over the full range of operating conditions. Results of the test are in the form of narrowband and one-third octave plots, comparing the affects of engine pressure ratio, flap angle, microphone location, and forward speed on the acoustic environment in the wing/flap region.

Author

N83-31421# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamics and Bioengineering Div

USAF (UNITED STATES AIR FORCE) BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 2: INDEX

J. N. COLE and N. J. PEACHEY Mar. 1983 21 p refs 2 Vol

(Contract AF PROJ 7231)

(AD-A126851; AMRL-TR-75-50-VOL-2) Avail NTIS HC A02/MF A01 CSCL 13B

This report is an index which identifies the individual volumes published during the 1975-1982 period by the Air Force Aerospace Medical Research Laboratory (AFAMRL) as a multi-volume report, "USAF Bioenvironmental Noise Data Handbook", AMRL-TR-75-50 and lists those aircraft, ground equipment and other systems reported there in. GRA

N83-31422# Dayton Univ., Ohio. Research Inst.

COMPUTER PROGRAMS FOR PRODUCING SINGLE-EVENT AIRCRAFT NOISE DATA FOR SPECIFIC ENGINE POWER AND METEOROLOGICAL CONDITIONS FOR USE WITH USAF (UNITED STATES AIR FORCE) COMMUNITY NOISE MODEL (NOISEMAP) Final Report

H. T. MOHLMAN Wright-Patterson AFB, Ohio AMRL Apr. 1983 339 p refs

(Contract F33615-78-C-0500, AF PROJ. 7231)

(AD-A127419; AFAMRL-TR-83-020, UDR-TR-82-30) Avail NTIS HC A15/MF A01 CSCL 09B

The Air Force community noise prediction model (NOISEMAP) is used to describe the aircraft noise exposure around airbases and thereby aid airbase planners to minimize exposure and prevent community encroachment which could limit mission effectiveness of the installation. This report documents two computer programs (OMEGA 10 and OMEGA 11) which were developed to prepare aircraft flight and ground runup noise data for input to NOISEMAP. OMEGA 10 is for flight operations and OMEGA 11 is for aircraft ground runups. All routines in each program are documented at a level useful to a programmer working with the code or a reader interested in a general overview of what happens within a specific subroutine. Both programs input normalized, reference aircraft noise data; i.e., data at a standard reference distance from the aircraft, for several fixed engine power settings, a reference airspeed and standard day meteorological conditions. Both programs operate on these normalized, reference data in accordance with user-defined, non-reference conditions to derive single-event noise data for 22 distances (200 to 25,000 feet) in a variety of physical and psycho-acoustic metrics. These outputs are in formats ready for input to NOISEMAP Author (GRA)

N83-31425# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Theoretische Stroemungsmechanik

PROPELLER NOISE AT SUBSONIC BLADE TIP SPEEDS, TORQUE AND THRUST FORCE

R STUFF Oct. 1982 95 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-821)

(DFVLR-MITT-82-17, ESA-TT-821) Avail NTIS HC A05/MF A01; DFVLR, Cologne DM 27,90

Sound generation due to propeller blade forces is described by an acceleration source. Closed form solutions are presented for the sound field of a propeller in yaw with asymmetric disk loading. The sound generation is assessed as a function of propeller blade forces (in dipole and quadrupole terms), of torque and thrust force by symmetrical and asymmetrical admission, as well as of forward speed. The three dimensional directional characteristics of an angular flux propeller are shown in an analytical formula.

Author (ESA)

N83-32517 National Physical Lab., Teddington (England). Acoustics Unit.

THE EFFECT ON THE MEASUREMENT OF AIRCRAFT NOISE OF REFLECTIONS FROM THE GROUND

R. C. PAYNE Dec. 1982 37 p refs

(NPL-AC-102, ISSN-0143-7143) Avail Issuing Activity

Data on the acoustic impedance of ground surfaces were used to estimate the influence of ground reflection on levels of aircraft noise measured at 1.2 m. It is shown that the effect on the perceived noise level can be determined by the pressure reflection coefficient at a frequency of 2 kHz, removing the requirement for information on acoustic impedance as a function of frequency. Techniques for determining the reflection coefficient of ground surfaces at a single frequency were evaluated and a procedure for in-situ measurements was developed. The reflection coefficients of a variety of ground surfaces are reported. Author (ESA)

N83-32518*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va

INTERIOR NOISE AND VIBRATION MEASUREMENTS ON OPERATIONAL MILITARY HELICOPTERS AND COMPARISONS WITH VARIOUS RIDE QUALITY CRITERIA

S. A. CLEVENSON, J. D. LEATHERWOOD, and D. D. HOLLENBAUGH (Army Research and Technology Labs., Fort Eustis, Va.) Aug 1983 82 p refs

(Contract DA PROJ. 1L2-62209-AH-76)

(NASA-TM-84664; L-15598; NAS 1.15:84664;

AVRADCOM-TR-83-D-21) Avail: NTIS HC A05/MF A01 CSCL 20A

The results of physical measurements of the interior noise and vibration obtained within eight operational military helicopters are presented. The data were extensively analyzed and are presented in the following forms: noise and vibration spectra, overall root-mean-square acceleration levels in three linear axes, peak accelerations at dominant blade passage frequencies, acceleration exceedance data, and overall and "A" weighted sound pressure levels. Peak acceleration levels were compared to the ISO 1-hr reduced comfort and fatigue decreased proficiency boundaries and the NASA discomfort criteria. The "A" weighted noise levels were compared to the NASA annoyance criteria, and the overall noise spectra were compared to MIL-STD-1294 ("Acoustical Noise Limits in Helicopters"). Specific vibration components at blade passage frequencies for several aircraft exceeded both the ISO reduced comfort boundary and the NASA passenger discomfort criteria. The "A" weighted noise levels, corrected for SPH-4 helmet attenuation characteristics, exceeded the NASA annoyance threshold for several aircraft. Author

N83-32575# Los Alamos Scientific Lab., N. Mex.

FLIGHT-SYSTEMS SAFETY PROGRAM Progress Report, Jul. 1982

S. E. BRONISZ, comp Jul. 1982 13 p

(Contract W-7405-ENG-36)

(DE83-001916, LA-9550-PR) Avail: NTIS HC A02/MF A01

This technical monthly report covers studies related to the use of Pu 23802 in radioisotope power systems carried out for the Office of Space Nuclear Projects of the US Department of Energy by Los Alamos National Laboratory DOE

SOCIAL SCIENCES

Includes social sciences (general), administration and management, documentation and information science, economics and cost analysis, law and political science; and urban technology and transportation

A83-42620**UNIVERSITIES - HAVE THEY A ROLE IN AERONAUTICAL RESEARCH? CONTRIBUTION TO RAES DISCUSSION EVENING**

A. D. YOUNG (Queen Mary College, London, England) Aeronautical Journal (ISSN 0001-9240), vol 87, June-July 1983, p. 225-228

The importance of university research in other countries is surveyed, with attention given to the US, Germany, France, and Holland. The absence of effective machinery in the UK for coordinating university research resources as part of a national program and arousing and sustaining the interests of university staff in the problems of industry is lamented. The abolition of the Aeronautical Research Council is regarded as an error. The staff of the university departments that formerly played an active role in aerospace research find themselves at a loss. They are in the dark as to the overall national research program and are increasingly uncertain where the important problems lie and what contributions they can make. Reconstituting the research council is seen as the ideal solution. In the meantime, it is recommended that the Royal Aeronautical Society follow the example of AIAA in the US in calling attention to key problems and setting up working groups to investigate them. C.R.

A83-43748**LIFE CYCLE COST APPLICATIONS TO CONCEPTUAL DESIGNS**

R. J. EBERL (Grumman Aerospace Corp., Bethpage, NY) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982 17 p (SAWE PAPER 1479)

A parametric approach to a life cycle cost (LCC) model for government military aircraft acquisition and operations is presented. The procedure takes into account the parameters which affect the weights, performance, reliability, and design of the aircraft, including all operations and support costs. Program segments are defined for the aircraft hardware, in-service operational costs, and the complexity of the design mission. Sizing the aircraft using computerized techniques permits rapid evaluations of tradeoffs between various performance parameters and vehicle configurations. The LCC inputs comprise considerations of cost and design related factors, engine details, avionics capabilities, and operations, support, and mission features. Estimations are also made of inflation, the cost of borrowing, and the timing of future disbursements. M.S.K.

A83-43749**DESIGN-TO-COST IN THE APPLICATION OF ADVANCED COMPOSITE TECHNOLOGY**

P. J. LESLIE (Bell Helicopter Textron, Fort Worth, TX) Society of Allied Weight Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982 19 p. (SAWE PAPER 1480)

Interdisciplinary design-to-cost (DTC) is an approach to the implementation of cost control for development program which is presently applied to advanced composite materials. Cost estimates yielded by the DTC process reflect a consensus of opinion among advanced cost technology, finance, industrial engineering, and manufacturing engineering teams, which base their predictions on both parametrical techniques and analytical methods grounded on historical data. During production, actual costs incurred during the fabrication of prototype composite components are tracked and

matched against earlier predictions. Attention is given to the case of cored and coreless laminate composites for helicopter construction. O.C.

N83-31519# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics

A LIFE CYCLE COST MANAGEMENT PRIMER FOR USE WITHIN THE AERONAUTICAL SYSTEMS DIVISION M.S. Thesis

A. K. DOUVILLE Mar. 1983 218 p refs (AD-A127267; AFIT-LSSR-80-82) Avail: NTIS HC A10/MF A01 CSCL 05A

The LCC Management Primer which serves as the basis for this thesis has been developed in response to the recommendation made by the audit team. It has been designed primarily to provide the notice LCC focal point a basis from which to establish a viable LCC Management program. That basis includes general guidance concerning the use of such accepted management tools as goals, trade-off analyses, and management control systems. It also includes a description of the documents used in managing a program and how those documents can precipitate program cost effectiveness through their LCC Management inputs. In addition to the benefits provided to the novice, the Primer should also be of some benefit to more experienced focal points. Specifically, the information provided in the Primer can serve as quick reference material for such key LCC Management elements as cost-related design goals. GRA

N83-32667# Management Consulting and Research, Inc., Falls Church, Va.

POM (PROGRAM OBJECTIVE MEMORANDUM) FY-85 BP 1500 COST GROWTH AND LEADTIME ADJUSTMENTS: RESEARCH RESULTS Final Report, 1 Oct. 1982 - 28 Feb. 1983

P. A. INSLEY and W. P. HUTZLER 28 Feb. 1983 85 p refs (Contract F33615-81-C-5018) (AD-A128522; MCR-TR-8229-1) Avail: NTIS HC A05/MF A01 CSCL 05A

This research, Phase 4 of Contract F33615-81-C-5018 (see MCR TR-8104-3), was divided into three tasks. Recommend data sources for FY-85 costs and leadtimes for BP 1500 Federal Supply Classes (FSC). Recommend procedure for incorporating cost and leadtime adjustments in the FY-85 projected budget requirements. Recommend specific price and leadtime adjustments for each Federal Supply Class. The researchers examined cost and leadtime trends, by commodity, and developed factors to be used in refining the BP 1500 cost per flying hour estimates developed by the Logistics Management Institute's Aircraft Availability Model (AAM). In addition to developing factor values to represent projected cost and leadtime trends, the researchers identified sources of data which could be consistently used as part of the requirements estimating process. GRA

N83-32677# Army Troop Support and Aviation Materiel Readiness Command, St. Louis, Mo. Cost Analysis Div.

HISTORICAL INFLATION PROGRAM. A COMPUTER PROGRAM GENERATING HISTORICAL INFLATION INDICES FOR ARMY AIRCRAFT, REVISION Final Report

W. H. GILLE, JR. and J. R. HAMILTON Mar. 1983 91 p refs (AD-A127674; TSARCOM-TR-83-1) Avail: NTIS HC A05/MF A01 CSCL 05C

This report extends and revises Technical Report 82-2 which presents and describes the Historical Inflation Program, a computer program generating historical inflation indices for Army aircraft. The program can be updated monthly, is easily revised for changes in Bureau of Labor Statistics methods, and is capable of handling data for all fiscal year formats. Output is expressed as monthly, quarterly, Fiscal Year, and Calendar Year inflation indices (in Calendar Year 1967 base) and inflation factors (in Fiscal Year base). This report contains updated tables of inflation factors, expressed in a FY 82 base. These indices and factors provide a means of adjusting historical cost data for the procurement of Army aircraft to constant year dollars. Additional features include: computations for the derivation of revised weighting factors, detailed indices enabling the adjustment of historical labor and

material costs separately, a discussion of aggregate weighting factors for labor and materials (including trends from sensitivity analysis with more background materials), and additional documentation aimed at making the report useful to a large cross section of the DOD rotary wing aircraft community. This report has been revised to include the latest information concerning the UH-60A BLACK HAWK.
 Author (GRA)

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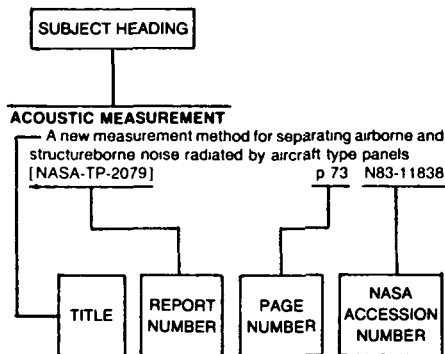
SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration, solar physics; and space radiation.

N83-30457# Joint Publications Research Service, Arlington, Va.
UNIFIED THEORY OF MOTION OF INNER PLANETS
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A highly accurate, unified theory of motion for the Solar System's inner planets Mercury, Venus, the Earth, Mars was developed. It has practical importance and is used to solve various problems of interplanetary cosmonautics.
 E.A.K.

Typical Subject Index Listing



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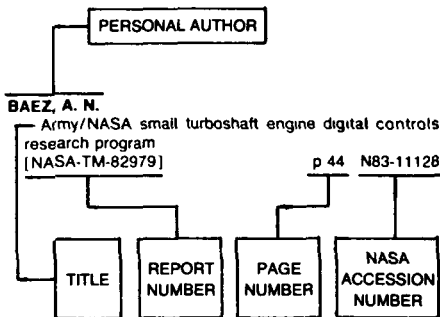
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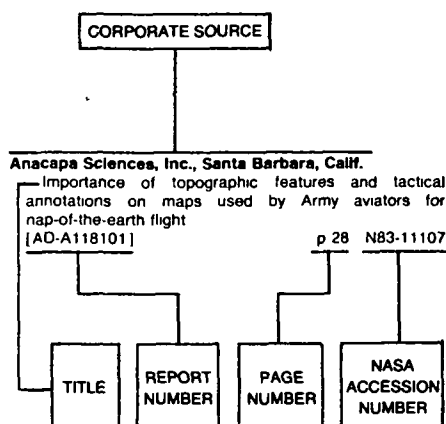
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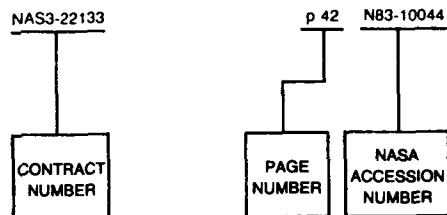
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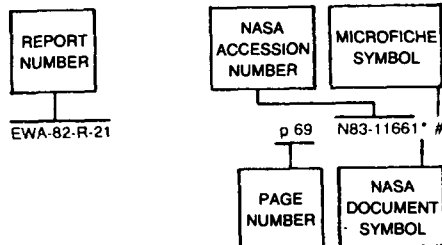
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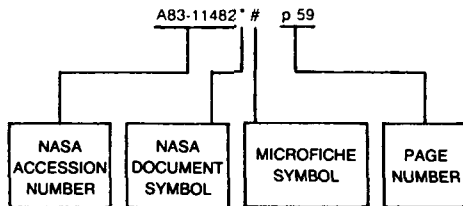
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